

SCIENCE

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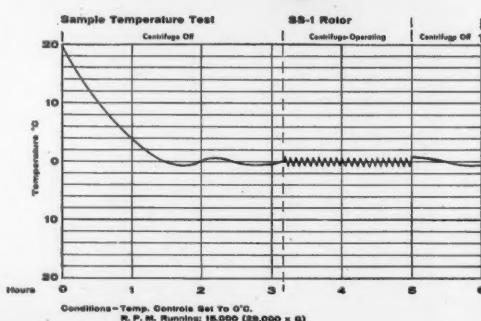
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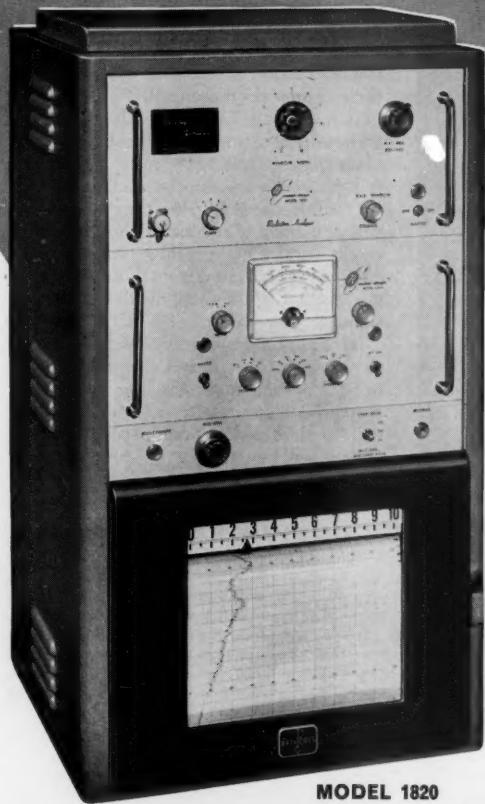
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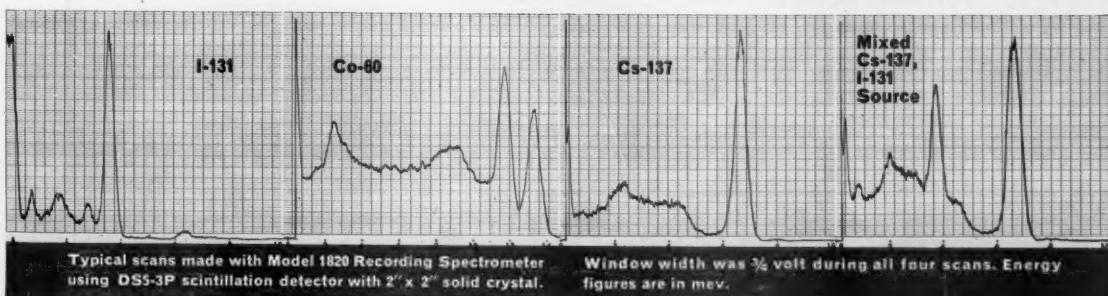
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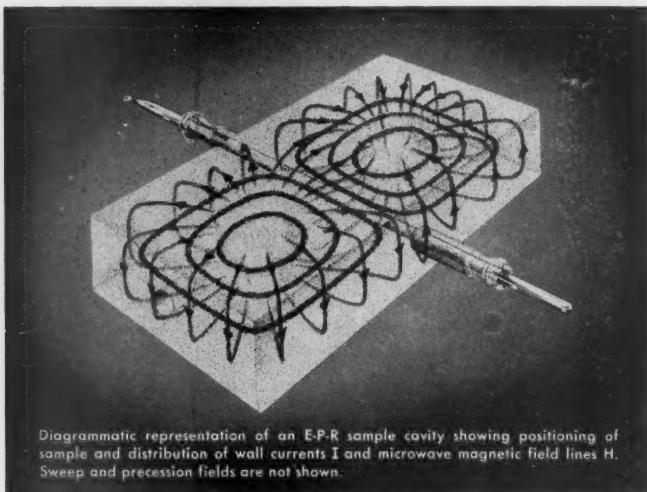
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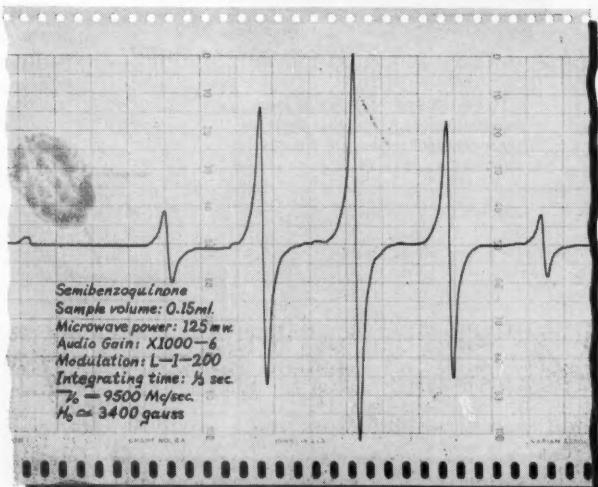
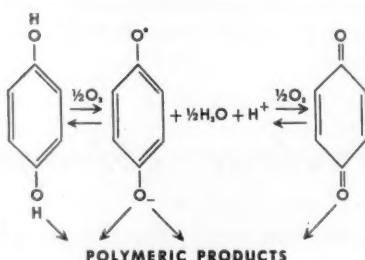
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Passive Voice

"Coming out of the subway, the tall buildings of New York were seen for the first time" is a type of sentence that most of us encountered in high-school English classes. Few of us caught on immediately to what was incorrect, but once the teacher had finally got it into our heads that the author did not intend to say that the tall buildings were coming out of the subway and that such a construction was called a "dangling modifier," many of us began to look for similar sentences just for the laughs.

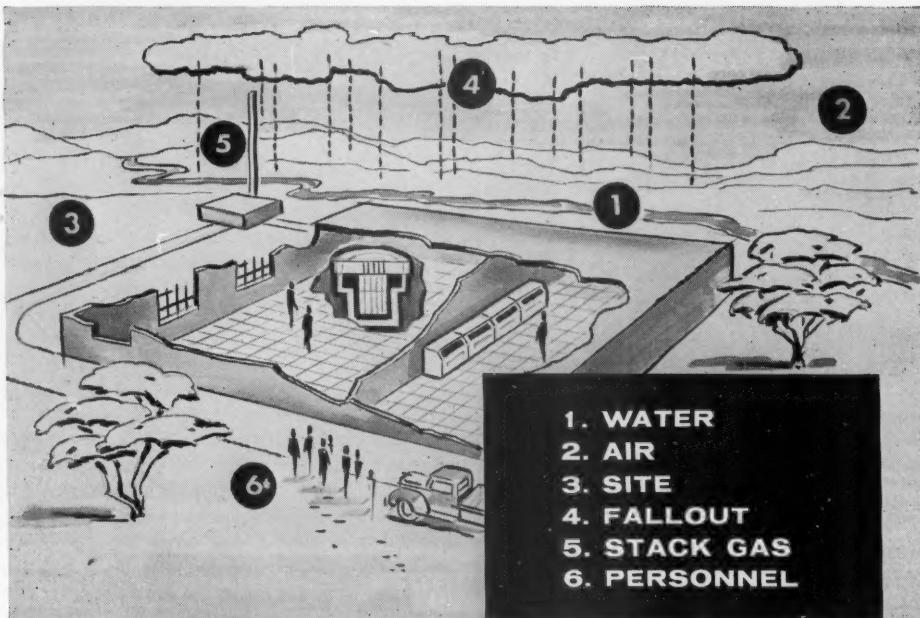
In the editorial office we still see gerunds and participles used in this manner, and it is discouraging. However, we have noticed that authors who prefer the passive voice fall into the trap more often than those who prefer the active voice. Once an author has written a few sentences in the passive voice, it seems to be easy for him to conclude the paragraph with a sentence like, "Adding acid drop by drop, a white precipitate was obtained."

When an author does this, we are obliged to make a change. Several courses are open to us. If most of the article is written in the passive voice, we try to change the phrase to an adverbial clause. For example, we may alter the wording to "When acid was added drop by drop, a white precipitate was obtained"—that is, we put the clause in the passive voice too. Or we can use a prepositional phrase beginning, for example, with *by*: "By addition of acid drop by drop, a white precipitate was obtained." There are other appropriate ways to correct the error. Sometimes, however, all these solutions are awkward, or else much of the article is written in the active voice. Under these circumstances, we find that it is necessary to shift the independent clause to the active voice: "Adding acid drop by drop, I [or we] obtained a white precipitate."

Occasionally the last solution disturbs authors, for some believe that the use of *I* or *we* is immodest, and others believe that this usage inserts a subjective element into the paper. *Science* has been trying to discourage the former view. Perhaps the authors who hold the latter view prefer the passive voice in general because they think it makes their writing more "scientific"—that is, that it makes their writing more "objective" and less "subjective," particularly when they are stating verifiable experimental facts.

We have no intention of joining those who belabor the use of the passive voice. Perhaps the active voice is, in general, more robust and more direct, and perhaps it does require a few (usually a very few) fewer words, but the passive voice can also be used well. Our chief objection to the passive voice is that it sometimes seems to make authors forget to watch for dangling modifiers. Such oversights can lead to something more undesirable than lack of grammatical exactness; they can also lead to scientific inexactness.—R. V. O.





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Our Reproductive Potential

Fairfield Osborn

The "reproductive potential" of the human race is at last being recognized as perhaps the most basic and certainly one of the most ominous problems facing the world today. It is, of course, overshadowed by the more immediate crises between freedom-loving peoples and the authoritarian forces of Communism. It is also secondary to the question, "Shall there be war or peace?" Yet, in the search for peace there is mounting evidence that the pressures resulting from rapidly growing populations are, without question, a major cause for the great majority of conflicts between nations. For my own part, I will go a step further and express my belief that the hope for world peace is remote, or even unattainable, until the pressures resulting from population growth are relieved.

Natural Checks to Population Growth

What is meant by *reproductive potential*? In a literal sense it expresses maximum fecundity. For our purposes here, we can better think of it in the more general sense of representing population trends within existing environments, both physical and cultural. The existing population problem is an anomaly, because man's capacity to reproduce himself rapidly is extremely low when compared with any other form of life. With the exception of a few of the higher mammals, man is the slowest "breeder" on earth.

The author is president of the Conservation Foundation and the New York Zoological Society. This article is based on an address which he delivered at a symposium on resource development and population growth, at the AAAS meeting in New York, 28 Dec. 1956.

Owing to a long gestation period culminating, usually, in only one offspring. Without overstressing the parallelism between man and other forms of life, it is well to recall that, in nature, overpopulation is prevented by three factors: starvation, disease, and natural enemies, the last, in human terms, being war. With regard to starvation and disease, great progress has been made in modern times in reducing the toll they both take upon human life. Consequently, these two checks to population growth have been largely eliminated, although near-starvation in the form of extreme undernourishment is today still prevalent with the majority of most people on the earth. With regard to warfare, we still fail to abolish it, or the threat of it, despite the universal yearning for peace. Here, again, it must be remembered that the numerical loss of human life in the last two great world wars was relatively inconsequential when measured against the total populations of the countries at war. In fact, the wars of the last century have had virtually no influence in restraining population increase in the countries engaged.

World Population Increase

In summary, then, the three natural controls upon population increase either have been largely removed or are of small influence. The consequence is that there has occurred a violent and completely unprecedented increase in populations throughout the world during the last century or more. Further, the rate of increase continues to accelerate. These facts are well known, but in order to

highlight them I should like to remind you that during the last 100 years the world's population increased from 1200 million to 2400 million, or an average of 12 million per year. By comparison, some 300 million people have been added to the earth's numbers within only the last 10 years, or an average of 30 million a year. One does not need a computing machine to figure out that this means more than 80,000 each day. At present the daily increase is estimated to be nearer 100,000 each day. These figures represent man's reproductive potential as of this time.

Within these over-all figures of world-population increase there are, of course, considerable variations in rates of growth between different regions and countries. It is noteworthy that the most recent upsurge in population is the result of the entry of most underdeveloped countries into the explosive phase of the demographic cycle.

It is a disconcerting irony that this extraordinary increase in human numbers has come about principally through the beneficent influence of medical science and public health measures, resulting in greatly reduced death rates. The question therefore is: How long can we accept this boon without facing up to the need for equivalently reduced birth rates?

Strangely enough, it is only within recent years that wide attention is being focused upon the far-reaching implications of this essential human problem. In historical times, it is true, various societies of people were acutely aware of the question of overpopulation, and not infrequently strict controls were enforced. In modern times the problem has been obscured for a number of reasons, including cultural, religious, and national attitudes. Further, during the last century or more, population pressures, especially in the Western world, have been relieved by new methods of transportation which aided migrations; by industrial development in many countries that absorbed ever larger labor forces; and, finally, by the fact that the settlement and development of the Western Hemisphere provided an outlet to great numbers of people in overcrowded countries. These reliefs can no longer be counted upon to any important degree.

Awakening of Interest in the Population Problem

In view of the fact that scant attention has been given to this world-wide question until recently, it is the more notable that, today, there is a great awakening to the seriousness of the situation. Within the last few years several governments, to which I shall refer shortly, are undertaking specific action toward population control. Further, the United Nations has given at least an initial nod to the existence of the problem by sponsoring, successively, two world conferences—the first, the United Nations Scientific Conference on Conservation and Utilization of Resources, held at Lake Success in August 1949, and more recently, the World Population Conference, held in Rome in August 1954. Quite apart from governmental interest, there have appeared in recent years a growing number of books, articles, and other publications on the subject, and many conferences by various groups have taken place, including discussions such as that recently held in New York under the auspices of the American Association for the Advancement of Science. Yes, action and interest are both "sharpening"—and, I might add, it is high time.

Schools of Thought

As one might expect, there are differences of opinion concerning this great question. In our country these have tended to crystallize into two schools of thought. Summarized, one school seems to assume that rapid and continued increase in populations throughout the world is inevitable and, consequently, that we should prepare for the time when the present world population may be doubled, or even tripled. Further, this school anticipates that it will be possible to provide for the physical needs, including food-supply, of such greatly increased populations largely through technologic means which, I might observe, are as yet scarcely, if at all, defined. Among the ranks of this group are physical scientists, engineers, and those engaged in the business and industrial world. These adherents deal with physical matters. Social and political consequences do not readily fall within their first interest.

The other school of thought does not and will not concede that rapidly increasing populations are inevitable throughout the indeterminate future. It will not concede this because it contends that, unless population growth is controlled, the human race will be entering into a mounting series of crises—social and political as well as physical. Expressing these warnings, representatives of this

school have sometimes been referred to as "the prophets of doom" and more generally as "the pessimists." Within this group will be found social scientists, political scientists, a growing number of historians, a limited number of economists, an occasional rebel from among the physical scientists, and, it might be added, most of the biologists. The adherents of this school tend to think in social and biological terms rather than in purely physical terms. Actually the members of this group are the optimists, because they hold to the belief that human society, when fully aware of the consequences of unrestrained population increase, will take positive steps to stabilize human numbers. This is already beginning to happen.

Action by Governments

Here let me refer to a few governments, the pioneers, that have started to take positive action toward restraining population growth. One of them is India, whose second five-year plan, issued in 1956, states, "The problem of regulating India's population from the dual standpoint of size and quality is of the utmost importance to national welfare and national planning." This statement is being made effective through the plan to establish 300 urban and 2000 rural clinics, under government supervision, to encourage birth-control. Another case is Japan, where abortion is legalized, and clinics for parent guidance have been established. It is estimated that between 1.5 and 2 million abortions were performed in Japan in 1955; this means that there were about as many abortions as live births—a distressing situation resulting from the fact that no more dependable means of birth control is as yet readily available to the people of that country. A third example, and an extraordinarily interesting one, is the change-about that has occurred in Communist China. Here there exists a basic conflict between Marxism, which holds that "the Malthusian theory of population is the most reactionary among the theories of the social sciences in capitalist society," versus the cold reality that a population of 600 million people, increasing at 2 percent per year, places an insuperable obstacle to the government's efforts to industrialize, to advance consumption levels, and to raise educational standards. Out of this welter of ideas and purposes the net result is that the government of mainland China has now accepted the extension of planned parenthood as one of its legitimate functions.

These three examples, evidence of governmental responsibility for the population status of the several countries con-

cerned, have all occurred within the last few years and are in themselves remarkable episodes in modern history. The question is, will this trend continue and how widespread will it become—and how rapid? An unparalleled opportunity, not yet accepted, is presented to the United Nations to take a position of world leadership in recognizing and becoming a focal center for coping with this problem that now so evidently affects the welfare of the peoples of every country.

Population Pressures and War

I stated earlier that population pressures are a principal factor in bringing on wars. There are, of course, other causes for war, including the "power complex" of ambitious leaders and governmental groups. However, Hitler used the need for *Lebensraum* as his excuse. Italy attacked Ethiopia to gain room for its rapidly expanding population, and Japan had imperative need for more space for a population that had increased from 47 million in 1900 to 73 million in 1940. This large and growing population was contained within Japan proper, a country equal in size merely to the state of Montana.

A vivid illustration of the tensions produced by a country's population pressures is provided by the present "hot spot," Egypt. This is an agricultural country depending mainly on the export of cotton for foreign exchange. Between 1937 and 1954 the Egyptian population grew from about 16 million to more than 22.5 million persons. During this period live births increased slightly, to 45 per thousand, and death rates fell from 25.7 to 17.7 per thousand. Over a period of three decades the average annual rate of population growth has been nearly 2.5 per cent—more than enough to double the population in 40 years.

Egypt's present population of more than 23 million is contained within the narrow strip of the Nile valley, an area of approximately 13,000 square miles (about that of Connecticut and Massachusetts). The population density is more than 2300 persons per square mile of arable land, and the struggle for the barest subsistence is acute. A people such as this, with little or nothing to lose, is an easy prey for dictatorship and aggressive action by its leaders.

If the controversial high dam were to be built at Aswan, and if all the impounded waters were to be used to increase the amount of cultivated land, the irrigated acres would be increased by one-third. Should this development of the productive base to the maximum limit take place, there would, even then, be only enough agricultural land to carry

the increment in population at present rates for a period less than a generation, without allowing for any rise whatsoever in level of living. As Stanley Cain recently expressed it: "Here is the stark biological problem—the race between production and reproduction that can't be won in Egypt by production alone."

Historian's Opportunity

These examples in very recent times indicate the degree to which population pressures contribute to international tensions and even war. Situations such as these, and many similar previous ones, present a fine opportunity for the present-day historian to go much deeper in analyzing causes of the great conflicts in human history instead of dealing principally with effects. Up to this time, too, many historians have "missed the boat" in this respect. Aldous Huxley, in one of his recent essays, "Tomorrow and Tomorrow and Tomorrow," writes, with understandable irony, "In the index at the end of the sixth volume of Toynbee's *A Study of History*, Popilius Laenas gets five mentions and Porphyry of Bata-maea, two; but the word you would expect to find between these names, Population, is conspicuous by its absence. In his second volume, Toynbee has written at length on 'the stimulus of pressures'—but without ever mentioning the most important pressure of them all, the pressure of population on available resources."

It is heartening to realize that Arnold Toynbee, learned man and eminent historian, has finally come to a full realization of the importance of what we are discussing here. In a broadcast, last October, he stated: "The abolition of war, working in combination with the lowering of the death rate through our recent vast improvements in public hygiene, is going to raise, in an acute form, the problem of population. . . . Is mankind going to rid itself of two of its three traditional scourges—war and pestilence—only to be done to death by the third scourge, famine? Surely we are not going to be so stupid as that. Yet, when we have done all that science can do to increase the world's food supply, the only way left open to us for coping with the continuing increase in population through the reduction of the death-rate will be to offset this increase by a corresponding reduction in the birth-rates."

Situation in the United States

There is a persistent tendency in our part of the world, the western world, to think and talk of the population problem as if it were peculiar to the Far East

and, more vaguely, to "underdeveloped" countries. There are grave errors in this attitude. One of them is that a number of countries in Europe are themselves faced with the problem, some to an aggravated degree. Another is that, if the Western world is going to assume any leadership in dealing with the problem as a whole, it will need, by its example, openly and avowedly to recognize its own involvement. Otherwise our motives—and this applies especially to us in the United States—will be subject to grave suspicion throughout the rest of the world. Why not, then, a candid examination of the situation in our own country?

Assuming that present rates of increase continue, we shall have 60 million more people in our country within 20 years. Our rate of increase, by the way, is greater than that of India, and even higher than the world average. Our prevailing attitude is one of taking it for granted that such an increase is desirable. There is much talk of "more sales," "expanding markets," and ever higher "standards of living." Fortunately our country has the benefit of enlightened leadership within the business and industrial world—an enlightenment that is steadily spreading, as evidenced, for instance, by the increasing support given by large corporations to "general welfare" projects such as education. Of late, business leaders and economists are beginning to analyze this "rising standard of living" theory and are questioning its validity. As Earle L. Rauber, director of research of the Federal Reserve Bank of Atlanta, aptly observed in a recent article, "it now takes all the running we can do to stay in the same place."

I believe that such benefits as may come to our country through a much larger population will be outweighed by the disadvantages and problems that will arise. Whether or not we shall be able to maintain our present standard of living is certainly open to question. There are related questions, such as: Will world conditions enable us to draw from other countries the continuing supplies of raw materials that today are essential to our economy? No one can answer this question with assurance. At the present time, with less than 10 percent of the free world's population and 8 percent of its land area, the United States has come to consume almost half the free-world volume of materials. One thing is sure—the greater the demand arising from the needs of an ever-larger population the more this question will press upon us, and the less likely it is that the answer will be affirmative.

On the domestic front we shall not actually run short of food, though, in all probability, surpluses will be a thing of the past, even within the next few years.

The great technical advances in forest management will presumably provide enough fibers, or substitutes will be developed. With regard to these two basic resources we need not have, perhaps, too great concern. The real pinch will come in water supply, already an acute problem for some 50 million people in various regions of our country. If the question were asked, "Can we solve this problem of insuring adequate amounts of these basic natural resources?" I think the answer would have to be a qualified *Yes*, because the natural richness of our country, the technical skills to be drawn upon, and the adaptability of our people are of such a high order. The qualification, however, is a major one—namely, that the larger our population, the more difficult the solution, the greater the threat to our economy, and, finally, the greater the chance of actual distress to large segments of the American people in the event that adequate solutions cannot be found.

These are material considerations. How about our environment and the cultural, psychological, and social situation in a "new America" with 75 or 100 million more people. Here indeed our thoughts must tread the tenuous tightrope of ideas and preconceptions. What kind of land, what kind of life do we want? Every city will be almost twice its present size; countrysides will become suburbanias; the traffic trickles and streams of 1956 will become ever-flowing rivers in the "80's"; the sky above us will be full of jets, with silent lake and mountain-valley hidden beyond "the last horizon." Perhaps this is what we want—or do we? It is all in the point of view, and we have not given it our thought as yet.

But there are more immediate and evident obstacles to making this "new America" a place for our children. Recently the *New York Times* carried a headline, "School outlook reported bleak." This news item had to do with the report of the National Education Association, which had just been issued and contained the following statements: "Our school systems still are employing about 80,000 teachers who are not fully qualified; enrollments in teachers' colleges are not gaining fast enough to meet the need for qualified new teachers, which this year is about 180,000"; and, finally, "at least 840,000 children are on half-day or similar part-time arrangements." Our colleges are in a similar position; unable to respond satisfactorily to the constantly increasing demands being made upon them. Virtually all our public services, hospitals, courts-of-law, other institutions, are, year by year, finding it increasingly difficult, in many cases impossible, to provide the quality of service that the public has a

right to expect. In these essential phases of our national life, with all our running, we cannot even stay in the same place!

There is no ready answer, nor is there any quick solution because our present attitude towards family size will compound these difficulties in the years immediately ahead. The choice lies with each parent. The individual is the nation. The choice, however, cannot be made until we formulate an opinion on what

we want for our country. In our inner thoughts we may be thankful that the problems which force this choice upon us are not as desperate as those facing the great majority of people in other countries. We can even dare to hope that they never will be. This, however, will depend on the decision we make—a decision which can serve our own interests as well as the interests of other people throughout the world.

A Social and Political Question

Above all, we should keep in mind the fact that the question of population growth, and the pressures it creates, whether considered from a national or an international point of view, is not merely a physical problem of resources and people. Even more essentially, if that be possible, it must be thought of as a social and political problem of world-wide magnitude.

Bacterial Particles in Oxidative Phosphorylation

Arnold F. Brodie and Clarke T. Gray

The biochemical function generally considered most characteristic of mammalian mitochondria is that of oxidative phosphorylation. While it cannot be said with certainty that bacteria possess subcellular elements which should be called mitochondria, recent studies (1, 2) have shown that cell-free extracts of mycobacteria and corynebacteria fulfill the most exacting requirements for oxidative phosphorylation. These include (i) oxidation of Krebs-cycle intermediates with P/O ratios greater than 1.0, (ii) formation of adenosine triphosphate (ATP) (3) from inorganic orthophosphate in the presence of a phosphate-acceptor system, (iii) absence of phosphate esterification under anaerobic conditions, and (iv) the uncoupling of phosphorylation from oxidation by known uncoupling agents. Microbial systems that couple phosphorylation to oxidation have since been described by Tissieres and Slater (4), Rose and Ochoa (5), and Hartman *et al.* (6) in extracts of *Azotobacter vinelandii*, while Nossal *et al.* (7) have obtained active preparations from yeast. In the foregoing systems the participation of subcellular particles has been demonstrated.

In contrast with the mammalian preparations, the bacterial systems studied (4, 8-10) have lent themselves to fractionation and reconstruction. In the

latter, oxidative phosphorylation is dependent on (i) a particulate fraction which functions only as a highly organized structural unit (9) and (ii) supernatant factors (4, 8, 10) required to complete terminal electron transport and coupled phosphorylation (11).

Since any system which can be fractionated and reconstituted facilitates analysis of the essential components, it appears that bacterial systems will play an increasingly important role in elucidating the mechanisms involved in oxidative phosphorylation. It seems useful, therefore, to characterize the labilities and also certain of the enzymatic and chemical constituents of bacterial particles that are capable of participating in oxidative phosphorylation (12).

Effects of Sonic Treatment

Active cell-free extracts were obtained by treating 11-milliliter aliquots of *Mycobacterium phlei* [500 milligrams of wet cells per milliliter of 0.1M tris (hydroxy-methyl) amino-methane (Tris) (3) at pH 8.0] in a 10 KC Raytheon magnetostrictive oscillator at 2°C for 4 minutes, followed by centrifugation of 20,000G (2). The effect of sonic vibration on cell disruption was measured by determining the rate of protein liberation. Protein was liberated rapidly during the first 4 minutes and but slowly thereafter (Table 1). The attendant solubilization of enzymes associated with the particles indicates

that extended treatment served primarily to fragment the debris and particles initially released.

Prolongation of vibration not only failed to increase the yield of protein, but it was also particularly deleterious, since it brought about a continuous decline in the capacity of extracts to esterify phosphate in the presence of succinate or fumarate (Fig. 1). Losses in the capacity to oxidize these substrates, however, differed quantitatively and qualitatively. Succinate oxidation was negligible after 40 minutes of treatment because of the apparent particulate nature of this oxidase. With fumarate as electron donor, about 60 percent of the initial oxidation remained. This residual oxidation with fumarate may be attributed to the solubilization of dehydrogenases and flavoproteins which transport electrons to oxygen by a series of noncoupled oxidative reactions. Such interpretation is supported by the more rapid decline of P/O ratios with fumarate and the increased cyanide-resistant residual oxidation with preparations that were treated for 40 minutes. Similar conclusions have been reached by other workers. Nossal (13) noted the solubilization of the fumarate system associated with yeast granules, while Utter and Kreech (14) obtained lowered P/O ratios when these granules were exposed to increased disruptive treatment. These observations with microbial systems parallel those concerning the lability of the mammalian mitochondrial system to sonic oscillation (15).

Distribution of Dehydrogenase Activity

A comparative analysis of the distribution of oxidative enzymes between particulate and supernatant fractions was investigated after these components had been separated from 4- and 40-minute sonic extracts. Crude cell-free extracts obtained by centrifugation at 20,000g were recentrifuged for 90 minutes at 140,000g in a Spinco preparative centrifuge (16). The particulate fraction was

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Table 1. Liberation of protein during sonic vibration of *Mycobacterium phlei*. A suspension of whole cells (44 milliliters) was divided into four aliquots of 11 milliliters each and subjected to sonic vibration for the intervals indicated. The protein liberated was measured (2) after sedimentation of remaining cells and debris at 20,000G. The mass of remaining cells and debris from each aliquot was washed with distilled water, retreated for 8 minutes, and re-centrifuged prior to determination of the protein liberated after the second treatment.

Whole cells		Remaining cells and debris		Total protein liberated (mg/ml)
Length of treatment (min)	Protein liberated (mg/ml)	Length of retreatment (min)	Protein liberated (mg/ml)	
2	26.7	8	3.6	30.3
4	30.0	8	3.1	33.1
8	31.1	8	1.1	32.2
40	31.6	8	0.83	32.4

resuspended in 0.15 M KCl at pH 7.4. Since oxygen consumption by the particles requires factors present in the supernatant (10), dehydrogenase activities of the particulate and supernatant fractions were measured with neotetrazolium as acceptor. The results obtained with succinate were confirmed manometrically by the phenazene methosulfate method of Singer (17).

Particles obtained from 4-minute sonic extracts contained most of the dehydrogenase activity for pyruvate, fumarate, α -ketoglutarate, malate, and succinate. The corresponding supernatant contained a small or negligible portion of the total dehydrogenase activity. After prolonged vibration, the enzyme activities in the particle fraction had decreased, while those of the supernatant were increased. The solubilization of particle-bound enzymes is shown in Table 2.

Distribution of Cytochrome Components

The liberation of particle-bound cytochromes during prolonged sonic vibration was also readily demonstrated by

analysis of cytochrome pigments (18) in particles and supernatants (Fig. 2). Cytochromes *a*, *b*, and *c* were found in the particles released by brief vibration, whereas the supernatant fraction contained only traces of cytochrome *c*. After prolonged sonic vibration, the particulate fraction contained only small amounts of cytochrome *c*; the hemochromogens corresponding to cytochromes *b* and *c* were detected in the supernatant, and cytochrome *a* could not be found in either fraction. The position of the cytochrome bands in extracts corresponded to those found by Todd (19) in suspensions of whole *Mycobacterium phlei*.

The Nadi reaction was used for further analysis of the activity of cytochrome oxidase. Particles obtained by short-term oscillation gave a positive Nadi reaction in 30 seconds. This reaction was inhibited completely by low concentrations of cyanide. In contrast, the supernatant, as well as the particles and supernatant obtained after lengthy oscillation, were negative after 20 minutes. With the mycobacterial system a positive Nadi reaction appears to denote intact particles capable of participating in coupled oxidative phosphorylation. Preparations which gave a positive reac-

tion within 1 minute usually gave good P/O ratios. In another microorganism tested, *Azotobacter vinelandii*, the correlation between these reactions is not as strict.

Active Particles from Extracts

The capacity for oxidation and phosphorylation is not shared by all the sedimentable components of cell-free extracts. An amorphous fraction obtained by centrifugation at 56,000g contained a high concentration of deoxyribonucleic acid (27 percent) and possessed no oxidative or phosphorylative capacity with succinate as substrate. Addition to this fraction of supernatant obtained by centrifugation at 140,000g resulted in a slight stimulation of oxidation but not in phosphate esterification. After the amorphous material had been removed, a particulate fraction was sedimented by centrifugation at 140,000g. This material contained 12 percent ribonucleic acid (20) and exhibited slight coupled activity with succinate. The functional significance of this particulate fraction in

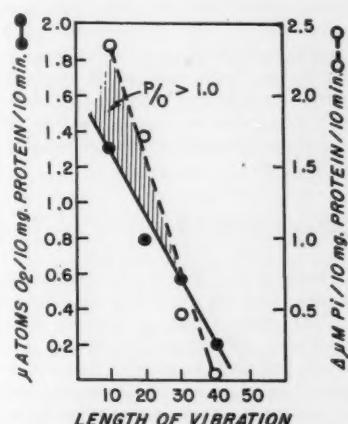


Fig. 1. Effect of sonic vibration on oxidation and phosphorylation. The system consisted of 10 micromoles of inorganic phosphate, 15 micromoles of MgCl₂, 25 micromoles of KF, 20 micromoles of potassium succinate, 2.5 micromoles of AMP, 1 milligram of yeast hexokinase, 20 micromoles of glucose, 0.8 milliliters of bacterial extract (pH 7.4), and water to a final volume of 1.3 milliliters. The extracts were obtained by sonic vibration of equal aliquots of suspended bacteria for periods of time ranging from 10 to 40 minutes. The protein concentrations were, respectively, 28.3, 27.1, 25.0 and 28.0 milligrams per milliliter. The respiration was measured by the conventional Warburg method at 30°C for 10 minutes after the addition of substrate, when it was stopped by the addition of 10-percent trichloroacetic acid; then the total inorganic phosphate was analyzed.

Table 2. Effect of sonic vibration on the dehydrogenase activity in particulate and supernatant fractions from *Mycobacterium phlei*. The reactions were carried out anaerobically in Thunberg tubes at 30°C. The system consisted of 0.1M Tris buffer (pH 8.0), 20 micromoles of substrate, 0.2 milliliter of fractionated extract, 200 micrograms of neotetrazolium, and water to a final volume of 1.1 milliliters. The diformazan formed was extracted with acetone and determined in the Klett photoelectric colorimeter using a No. 54 filter.

Preparation	Diformazan formed (μg/min 10 mg of protein)				
	Pyruvate	α -ketoglutarate	Succinate	Fumarate	Malate
<i>Sonic treatment 4 min</i>					
Particles (140,000g)	8.6	9.0	15.0	10.0	10.2
Supernatant	0	3.5	0.5	4.9	4.4
<i>Sonic treatment 40 min</i>					
Particles (140,000g)	0.0	0.2	2.5	3.0	3.0
Supernatant	3.1	8.3	1.2	9.5	11.2

Table 3. Effects of dialysis on bacterial oxidative phosphorylation. The crude extract was dialyzed for 20 hours against cold distilled water, and the values reported for the dialyzed material were adjusted to correct for dilution of the protein. Reactions were carried out at 30°C for 10 minutes after the addition of substrate. The Warburg vessels contained 13 micromoles of inorganic phosphate, 15 micromoles of $MgCl_2$, 25 micromoles of KF, 50 micromoles of potassium succinate, 5 micromoles of AMP, 3 milligrams of yeast hexokinase, 20 micromoles of glucose, 14.6 milligrams (protein) of crude sonic extract (pH 7.4), and water to a final volume of 1.3 milliliters. The concentration of added cytochrome *c* was $1 \times 10^{-4} M$.

System	Fresh extract			Dialyzed extract		
	Oxygen (μ atom)	ΔP_i (μ mole)	P/O	Oxygen (μ atom)	ΔP_i (μ mole)	P/O
Complete system	7.8	10.3	1.34	3.17	1.23	0.39
Complete system + cytochrome <i>c</i>	8.3	11.7	1.42	2.53	1.23	0.48
Complete system + Kochsaft	7.9	11.8	1.49	3.5	1.0	0.29

coupled oxidative phosphorylation is shown by a four- to seven-fold increase in activity on the addition of 140,000g supernatant. This supernatant was free of particles and, when tested separately, showed no significant oxidation or phosphorylation.

Electron microscopy revealed two distinct classes of particles sedimenting between 100,000g and 140,000g—large particles (70 to 180 millimicrons) and smaller particles (20 to 40 millimicrons). Since the large and small particles tended to sediment together, it is difficult to ascribe the coupled activity to either particle until further fractionation is achieved.

Influence of Environment

Suspension of intact cells in isotonic sucrose prior to oscillation, or dilution of the crude extract in sucrose after oscillation, offered no advantage: extracts prepared in distilled water displayed equal activity. This would seem to be in contrast with mammalian mitochondrial suspensions, which require careful control of isotonicity during preparation as a prerequisite for activity. However, the crude bacterial extracts were obtained by oscillation of thick cell suspensions yielding large amounts of native protein and lipid, which appear to exert a protective action on the particles in the crude ex-

tract. Particles isolated by high-speed centrifugation approximated mammalian mitochondria in their sensitivity to chemical agents and changes in the environment.

Dialysis of crude extracts for 24 to 48 hours had a pronounced effect on the enzymatic activity and on the integrity of the particles. Dialyzed preparations had lowered oxidative activity and even lower phosphorylative capacity (Table 3). The addition of Kochsaft (boiled yeast or bacterial extracts) or cytochrome *c* to the dialyzed extracts partially restored the oxidation with certain substrates—for example, malate—whereas phosphate esterification was not restored even by the further addition of di- or triphosphopyridine nucleotide. Harmon and Feigelson (21) found that the addition of cofactors to suspensions of mammalian mitochondria prepared in distilled water partially restored oxidation in some preparations. The activity was correlated with changes in the shape of the mitochondria. When dialyzed bacterial extracts were examined either by electron or phase microscopy, only a few particles could be observed.

The effects of freezing and storage on crude extracts are presented in Table 4. The P/O ratios obtained with preparations treated in this manner were considerably reduced. Damage by freezing followed the general pattern already reported to characterize mammalian mitochondria (22). Oxidation usually remained active, while phosphorylation was impaired.

Evidence that intact particles behave as reversible osmotic systems was obtained in various ways. The appearance of the bacterial particles under the phase microscope is altered when they are suspended in KCl (0.05 to 1.5M). Hypotonic solutions tended to swell the particles into smooth spheres many times their original size. Particles treated in this manner could couple phosphoryla-

tion to oxidation if they were used immediately. When suspended in hypertonic solutions, the particles were clumped, with an attendant loss in the coupled activity. Particles suspended in gramicidin ($1 \times 10^{-4} M$) became swollen and rough in appearance within 5 minutes and then slowly clumped into large aggregates of misshapen particles. This effect of gramicidin is correlated with our earlier observation that the uncoupling action of gramicidin is dependent on the suspending medium employed (2). Both the uncoupling action of gramicidin and the inhibitory action of malonate on succinoxidase occur to a greater extent in extracts prepared in water than in those made in isotonic sucrose.

When concentrated sucrose was added to water extracts or water to sucrose extracts, with tubes containing homologous diluents as controls, turbidity measurements indicated that the particles in the extracts behaved as a reversible osmotic system. The osmotic characteristics of these bacterial particles are thus similar to those described by Hogeboom *et al.* (23) and Lehninger (24) for mammalian mitochondria.

Discussion and Summary

Of the two components in bacterial extracts required for coupled oxidative phosphorylation, it is the particles which are sensitive to physical manipulation (8, 9) such as sonic vibration, dialysis, aging, freezing, and changes in tonicity. The supernatant factors (10) are resistant to such treatment. Furthermore, the physical integrity of the particles and their ability to conduct oxidative phosphorylation are far more labile than is

Table 4. Effects of freezing.

Complete system*	O ₂ (μ atom)	ΔP_i	P/O
Fresh extract	3.52	5.2	1.48
Frozen extract (24 hr)	3.90	2.4	0.61

* Conditions were similar to those described in Table 3. Succinate was used as substrate.

CYTOCHROME COMPONENTS IN FRACTION OF *M. PHLEI*

SONIC VIBRATION (MIN.)	PREPARATION	ABSORPTION SPECTRUM M _μ		
		540	580	620
4	SUPERNATANT	^a 550	^b	^b
	PARTICLES	^c 550 564	^b	598
40	PARTICLES	^c 550	^b	
	SUPERNATANT	^c 550 564	^b	

Fig. 2. Cytochrome components in fractions of *Mycobacterium phlei*. After reduction with $Na_2S_2O_4$, the fractions were examined for their cytochrome components by means of a Zeiss hand spectroscope at room temperature and immersion in liquid air. The exact positions of the bands were determined with the aid of a Cary automatic spectrophotometer. Cytochrome *b* was also analyzed as the pyridine-hemochromogen complex by the method of Pappenheimer and Hender (27).

their ability to transport electrons to oxygen. Such data indicate the necessity for highly organized particles in which the spatial arrangement of the enzymes and bound coenzymes is important for coupled oxidative phosphorylation. It is apparent, however, that it is dangerous to characterize enzyme systems as particulate or soluble in nature when harsh disruptive procedures are used and when full recognition of the inherent potential of the particles is not used as a base line. We have here used a sensitive indicator of structural integrity, oxidative phosphorylation, as a measure of the degree to which the system can be assumed to represent the pattern of enzyme localization in the intact cell. We realize, however, that some pitfalls common to almost all cell fractionation procedures (25) may still apply.

In many respects—for example, in regard to function and degree of presumed organization—the bacterial system resembles the mammalian mitochondrial system (26). Certain differences do exist. These include the greater stability of the particles and the soluble nature of factors necessary for coupled activity in the reconstructed bacterial system. Because of

these differences, the bacterial systems provide an excellent tool for studying certain aspects of the mechanism of coupled oxidative phosphorylation.

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C. A. Chant, Father of Canadian Astronomy

On 18 November 1956, Clarence Augustus Chant died at the age of 91. For more than 60 years he had been an enormous power behind Canadian astronomy, and the many astronomical seeds which he planted will continue, as strong trees, to bear the fruit of his labors for decades to come.

It was he who was largely responsible for the formation of the Royal Astronomical Society of Canada 60 years ago, for the founding of its monthly *Journal* and annual *Observer's Handbook*, for the setting-up of the department of astronomy at the University of Toronto, and for the establishment of a research observatory and large telescope belonging to that institution. He also made a real contribution to the wide dissemination of scientific knowledge. Textbooks of which he was coauthor—*High School Physics, Mechanics for the Upper School*,

and *A Text Book of College Physics*—have instructed several generations, totaling hundreds of thousands, of Canadian high-school students. His popular book on astronomy, *Our Wonderful Universe*, has been published in three English editions and translated into five foreign-language editions. Over the years most of the Canadian astronomers, including five of the directors of the large Canadian observatories, were numbered among his thousands of students.

Chant was born on 31 May 1865, in Ontario, near Toronto. After attending Ontario high schools he was graduated in 1890 from University College, Toronto, and joined the staff there in 1891. From that time on he gave continuous service to the University of Toronto, except for a brief interval when he studied for his Ph.D. degree at Harvard in 1901.

From the time he, as a graduate student in physics, grew interested in astronomy, his life became one of unswerving devotion to the cause of astronomy in Canada. A slight, spare man, of remarkable health and strength, in his later years he typified the hale old age of excellent mental and physical powers which is the dream of many but the reward of few. His vast memory for facts and events remained with him to the end and, combined with his great erudition, made a chat with him a real treat. When the David Dunlap Observatory was built, he and his wife moved from the heart of Toronto, where they had resided for more than 40 years, to the lonely hilltop which the observatory occupies, 10 miles north of the city. Until 2 years before his death he worked daily in his office at the observatory.

A clear and concise teacher, he had a remarkable memory for his students and followed their careers with interest. He took part in five solar eclipse expeditions, including one to Australia in 1922 where photographs confirmed the Einstein displacement of starlight as it passes the strong gravitational field of the sun. Among the recognitions of his achievements were his election as president of the Royal Astronomical Society of Canada, as vice president of the American Astronomical Society, as fellow of the Royal Society of Canada, and his award of a silver medal at the Harvard tercentenary. In 1940 the Royal Astro-

nomical Society of Canada established the Chant medal for outstanding Canadian amateur astronomers.

Superposed on the background of steady day-to-day efforts were memorable dramatic moments in his life. He was a pioneer in the application of x-ray photography and in February 1896 took a shadow-picture of a woman's heel, by means of which a steel needle was located. He sent the first wireless telegraph message in Canada in November 1899, when a message was carried from one side to the other of a lecture room in University College. His long struggles toward the establishment of a large observatory at Toronto, after years of frustration and disappointments, had a dramatic culmination. Through the gen-

erosity of the late Mrs. Jessie Donalda Dunlap, as a memorial to her husband, some of the golden riches from the depths of Canadian mines were fittingly transformed into a beautiful observatory for exploring the worlds beyond. The David Dunlap Observatory, with its 74-inch reflecting telescope—at that time the second largest in the world—was formally dedicated on Chant's 70th birthday, on which day he became director emeritus and received an LL.D. degree from the University of Toronto.

A major task of his life was his editorship of the *Journal of the Royal Astronomical Society of Canada*, which he had founded and edited from its beginning. As late as the issue of September 1956, he contributed an article, the

obituary of his old friend Walter S. Adams of the Mount Wilson Observatory. As the last issue of volume 50 of the *Journal*, of which he was still editor, was on the press, his lifework ended. A record of exactly 50 years of continuous editorship of a scientific journal has few challengers.

In his life, as he followed the pathway to the stars, he typified the motto of the society he founded: *Quo Dicit Urania*. Canadian astronomers agree with Harlow Shapley who, on hearing of Chant's death, wrote, "No one can so rightly be adjudged the father of his country's astronomy and astronomers as Dr. Chant."

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News of Science

Mellon Institute to Cultivate Fundamental Research

Plans recently adopted by the board of trustees of the Mellon Institute, Pittsburgh, Pa., call for a major expansion of fundamental research in that institution. According to Matthew B. Ridgway, the board chairman, the decision to reorient the institute's principal investigational activities toward long-range basic scientific objectives represents the culmination of a broad assessment of the role of the institute over a period of several years. In this appraisal, the advice and counsel of eminent scientists from academic life and from the industries were brought to bear on the question of the types of effort in which Mellon Institute could make its greatest contributions in the future under the leadership of Paul J. Flory, executive director of research.

The imperative need for more active replenishment of the reservoir of scientific knowledge through fundamental research is widely recognized. Yet, notwithstanding the funds available for the support of research, the progress of fundamental science has seriously fallen behind the proliferation and consequent requirements of applied science and technology. For these reasons it has been concluded that Mellon Institute can perform a service to the sciences and indus-

tries and, hence, to the nation by structuring its organization as a center of advanced investigation, with comprehensive attention to fundamental problems. The course decided upon is a reaffirmation of the original purpose of the institute, a nonprofit institution founded in 1913 and dedicated to scientific research for the benefit of mankind.

Although it is the aim eventually to direct the institute's main efforts along the lines of fundamental scientific research, there is no intention to depart from the field of applied research. Indeed, a healthy collaboration between fundamental and applied research will be fostered. In applied research, investigation of long-range character, or pioneering nature, will be especially encouraged. Then, too, much of the fundamental research will naturally enter potentially practical areas that will invite industrial participation. Ultimate possibilities of technologic application will not, of course, be regarded as criteria for judging the scientific merit of fundamental research undertakings. As is well known, however, results of fundamental investigation, totally unactuated by economic considerations, may now and then reveal high utility.

Fundamental research is contemplated in fields embracing physical chemistry, chemical physics, and inorganic, organic,

and analytic chemistry. Solid-state investigations, polymer chemistry and physics, radiation studies, and biophysics and biophysical chemistry will be emphasized, according to present plans. The importance of granting freedom commensurate with ability to individual research workers is recognized, and a wide latitude of opportunity will be assured for creative research. Members of the research staff will be encouraged to direct their efforts toward significant objectives of their own choosing, and to evolve their own problems and programs. Thus the institute will nourish professional motives pointed at generating new ideas of value in scientific investigations for human welfare.

AAAS Socio-Psychological Prize

Through the generosity of an anonymous donor, the AAAS offers an annual prize of \$1000 for a meritorious essay in socio-psychological inquiry. Previous winners of this prize and the titles of their essays have been: Arnold M. Rose, "A theory of social organization and disorganization"; Yehudi A. Cohen, "Food and its viscidities: a cross-cultural study of sharing and non-sharing in sixty folk societies"; and Herbert C. Kelman, "Compliance, identification, and internalization: a theoretical and experimental approach to the study of social influence."

The conditions of competition for the prize to be awarded at the 1957 annual meeting, Indianapolis, 26-31 Dec., are as follows.

1) The contribution should further the comprehension of the psychological-social-cultural behavior of human beings—the relationships of these hyphenated words being an essential part of the inquiry. Whether the contributor considers

himself to be an anthropologist, a psychologist, a sociologist, or a member of some other group is unimportant as long as his essay deals with basic observation and construction in the area variously known as social process, group behavior, or interpersonal behavior. For ease of reference in the rest of this statement, this general area will be called "social behavior."

2) The prize is offered to encourage studies and analyses of social behavior based on explicitly stated assumptions or postulates, which lead to experimentally verifiable conclusions or deductions. In other words, it is a prize intended to encourage in social inquiry the development and application of dependable methodology analogous to the methods that have proved so fruitful in the natural sciences. This is not to state that the methods of any of the natural sciences are to be transferred without change to the study of social behavior, but rather that the development of a science of social behavior is fostered through observation guided by explicit postulates, which in turn are firmly grounded on prior observations. It may be taken for granted that such postulates will include a spatial-temporal framework for the inquiry. It may properly be added that the essay should foster liberation from philosophic-academic conventions and from dogmatic boundaries between different disciplines.

3) Hitherto unpublished manuscripts are eligible, as are manuscripts that have been published since 1 Jan. 1956. Entries may be of any length, but each should present a completed analysis of a problem, the relevant data, and an interpretation of the data in terms of the postulates with which the study began. Preference will be given to manuscripts not over 50,000 words in length. Entries may be submitted by the author himself or by another person on his behalf.

4) Entries will be judged by a committee of three persons considered well qualified to judge material in this field. The judges will be selected by a management committee consisting of the chairman and the secretary of Section K and the executive officer of AAAS. The committee of judges reserves the right to withhold the prize if no worthy essay is submitted.

5) Entries should be sent to Dael Wolfe, Executive Officer, American Association for the Advancement of Science, 1515 Massachusetts Ave., NW, Washington 5, D.C. Entries should be submitted in quadruplicate. Each entry should be accompanied by four copies of an abstract not to exceed 1200 words in length. The name of the author should not appear anywhere on the entry itself but should be enclosed on a separate sheet of paper which also gives the au-

thor's address and the title of his essay. Entrants who wish to have their manuscripts returned should include a note to that effect and the necessary postage. To be eligible for consideration for the prize that will be awarded at the 1957 annual meeting of the Association, entries must be received *not later than 1 Sept. 1957*.

Dental Education at Rochester

In view of the increased national demand for teachers and investigators in dentistry, the University of Rochester has decided to expand its efforts in graduate dental education. Through a training grant from the U.S. Public Health Service and through industrial grants in addition to university funds, a number of fellowships with stipends ranging from \$3000 to \$5000 per year are now available to dental graduates. Candidates may work for the Ph.D. or the M.S. degree in one of the basic sciences or for the M.S. degree in dental science, or they may conduct research as research associates.

Rockefeller Foundation

Rockefeller Foundation grants during the fourth quarter of 1956 totaled \$8,104,849. Grants in the field of medical education and public health amounted to \$1,064,709; biological and medical research, \$1,147,260; agriculture, \$2,568,195; social sciences, \$703,375; humanities, \$1,051,310; and general appropriations, \$1,570,000. During the same period the foundation awarded 36 fellowships to individuals from 17 countries.

In this fourth quarter the foundation also expanded its agricultural program. When a foundation staff member arrived in India in January, the agricultural operating program of the foundation was for the first time extended outside Latin America. The aim of the new project is similar to that of the Latin American work from which it derives: to increase production of the basic food crops of the country through research and training projects. For the support of the new unit in India and for the continuance of the units in Latin America, the foundation has appropriated \$1,481,500 for the calendar year 1957.

At the invitation of the Ministry of Agriculture of India, foundation staff members will cooperate with Indian officials, scientists, and teachers in the organization of a central postgraduate school of agriculture in connection with the Indian Agricultural Research Institute at New Delhi, and in the development of research projects in cereal crops, with special reference to corn, sorghum,

and millets. Both the ministry and the foundation are helping to meet the costs of the necessary buildings, equipment, and supplies to launch the program.

Three closely related types of activities constitute the agricultural program of the Rockefeller Foundation. One is the direct operation by staff members and their local associates of research and demonstration projects leading to the improvement of food crops of major importance to the host country. Four such projects are now in operation: in Mexico, Colombia, and Chile, and the new one in India.

The second is a system of fellowships, scholarships, and travel grants designed to enrich the experience and broaden the training of selected younger scientists. Many of the fellows and scholars have had preliminary training under the supervision of staff members in one of the operating centers. More than 400 Latin American graduates of agricultural colleges have had advanced training experience of this sort in the 14 years of the system's operation, and already a number of the earlier appointees have returned and been advanced to positions of responsibility in ministries of agriculture, colleges of agriculture, research agencies, and private industry; a number of them are themselves helping in the training of a still younger generation of technicians and scientists.

The third aspect of the work consists of grants to universities and other institutions for the support of education and research in the agricultural sciences. The grants are oriented toward agricultural education leading to the production of increased numbers of qualified graduates, toward the application of agricultural techniques to crop and animal improvement, or toward the support of fundamental research with potential long-range benefits to agricultural science and production. In seeking these objectives, the foundation has made grants to faculties of agriculture in Latin America and Asia, both for the strengthening of instruction and for the expansion of research activities. The grants made to institutions in the United States and Europe have, in general, emphasized research of a very fundamental type.

Of the four centers where foundation staff members cooperate directly in research and training, the oldest is the one in Mexico, established in 1943. A staff of 18 scientists operates four experiment stations, located in climatically different regions, and collaborates in the technical work of a number of other federal and state stations. About 70 graduates of agricultural colleges in Mexico and other Latin American countries join the Mexican office annually for from 3 to 18 months of practical field experimentation experience in their specialties. The

research work on the genetics, protection, and management of the basic food crops has now yielded results upon which firm recommendations can be made to farmers in terms of the soil and climatic conditions of their local regions, and seed of many improved varieties is ready for their use. With these recommendations and materials available, there is a basis for effective extension, and a system of regional resident "county agents" has been put into operation by the Ministry of Agriculture with important success. The ministry has consistently enlarged its direct and indirect financial support of the collaborative project.

The increased production of several food crops which Mexico is now enjoying is due in part to such factors as larger supplies of fertilizers and more irrigated farmland but, in important respects, is also the result of research and extension. The wheat crop, now sufficient to meet local demand for direct consumption, is grown almost entirely from seed of higher yielding, disease-resistant varieties developed through research. Hybrid and other improved corn varieties have been furnished which make possible a substantial increase in the corn crop. Better beans, tomatoes, and other vegetables have been produced. Recent research on the late blight disease of potatoes opens the possibility that potato varieties highly resistant to this scourge may be in the offing. A new poultry improvement project has aroused great interest among small farmers and their families and among commercial raisers, who evince enthusiasm for increasing the production of chickens and eggs as a source of much needed animal proteins.

An extremely important result of the cooperative project is the outstanding performance of growing numbers of well-trained young Mexican technologists, teachers, and investigators, who are reinforcing all aspects of professional agricultural work in Mexico and who are assuming responsibility for a number of projects formerly handled by foundation staff members.

The ten scientists on the staff of the foundation in Colombia operate a large central experiment station near Bogotá and five regional stations. Their work, now in its seventh year, is concentrated on training and research on foodstuff production, chiefly corn, wheat, beans, potatoes, and feed crops; and it has recently been extended to poultry and livestock improvement.

The office serves as a training center for graduates of schools of agriculture in Colombia and in neighboring countries of the high Andean region and has sponsored the advanced training of a number of these through fellowships and scholarships to Mexico and the United States. The work of the unit is finan-

cially supported by both the Ministry of Agriculture and the foundation.

The work in Chile began in the spring of 1955 and is concentrated on two crops—wheat and forages for livestock feed. Research has been begun in the three chief agricultural regions of the country. Large numbers of plant materials from Mexico and Colombia are being tested for adaptation and will be used with selected local varieties for increase or as the basis for hybridization for the development of better and higher-yielding varieties suited to Chilean conditions. Experiment station and other facilities are also being improved.

Crop improvement research is being extended into neighboring countries in a type of operation which is not handled directly by the foundation but which stems from the work it has done. In Central America the six governments have each established local corn improvement programs staffed by nationals but using materials from the Colombian and Mexican corn-breeding work as a basis for developing autonomous seed and improvement projects. The six local projects were established with orientation and aid from the foundation, and through cooperation of foundation staff representatives they are linked into an effective international group. During the 3 years the work has been in force, appreciable improvement has been made in the quantity and quality of corn produced, in the number of Central American scientists who have been trained for positions within their countries, and in the growth of interest on the part of administrators and agricultural producers in the utilization of improved methods and materials for greater economic benefits.

In Ecuador the Ministry of Agriculture is establishing a wheat-improvement project. As in the Central American corn program, a member of the foundation staff—in this case the leader of the wheat work in Colombia—provides technical advice and guidance. Both Ecuadorian and Colombian agricultural scientists participate in the effort.

The international cooperative activities of the operating centers are being continued and strengthened. The foundation is responsible for two of the corn germ plasma banks which are part of the plan of the National Research Council for preserving genetically valuable varieties. These germ plasma banks send seed to scientists all over the world. Those in charge of the work with wheat cooperate with the international wheat rust nursery project of the U.S. Department of Agriculture. In the fight against the late blight disease of potatoes, the foundation puts its facilities in the high Valley of Toluca in Mexico at the service of scientists in a dozen different coun-

tries and research centers for testing promising types of commercial potatoes against the virulent strains of the disease there which are found at no other place in the world.

Paraplegia Fellowships

The National Paraplegia Foundation has announced the continuation of a limited number of fellowships for research in spinal cord disease and trauma and in the complications commonly associated with such disease or injury. These fellowships carry a minimum stipend of \$3000 per year and may be awarded to any candidate who has demonstrated a capacity for medical research and has outlined a program of meritorious study.

Application forms for the 1957-58 academic year may be obtained from the chairman of the Medical Advisory Committee, Dr. L. W. Freeman, and completed forms should be submitted to him not later than 15 Apr. at the National Paraplegia Foundation, 1940 W. Michigan St., Indianapolis 7, Ind.

Academic's Two New Journals

Academic Press, New York, has announced publication of two new journals. *Annals of Physics*, a new monthly that is scheduled for release in April, will be under the editorship of Philip M. Morse, professor of physics at Massachusetts Institute of Technology. Assistant editors are Bernard T. Feld and Herman Feshbach of M.I.T., and Richard Wilson of Harvard University. They will be advised by an editorial council that includes E. Amaldi, R. F. Bacher, H. A. Bethe, S. Chandrasekhar, E. M. McMillan, L. Nordheim, J. R. Oppenheimer, R. E. Peierls, I. I. Rabi, F. Seitz, E. P. Wigner, and C. Zener.

Original articles on research in any branch of physics may be submitted. *Annals of Physics* hopes to provide a medium for the publication of important papers that are internally complete and, thus, are generally understandable to professional physicists working in other fields. The length of articles will not be a limiting factor.

The other new periodical is the *Journal of Molecular Spectroscopy*, which will be edited by Harald H. Neilsen of the department of physics at Ohio State University. The editorial board consists of Børge Bak, W. S. Benedict, Bryce L. Crawford, Jr., David M. Dennison, Michael Kasha, P.-O. Lowdin, S. Mizushima, James N. Schoolery, G. B. B. M. Sutherland, C. H. Townes, H. L. Welsh.

The journal will be devoted to publication of original research papers deal-

ing with molecular spectra in emission and absorption, molecular spectra in the ultraviolet, the visible, the near, and the far infrared, and in the microwave region. It will also contain contributions on Raman spectroscopy and radiofrequency spectroscopy (including nuclear magnetic resonance spectroscopy). Manuscripts dealing with both the experimental and the theoretical aspects of molecular spectroscopy will be welcomed.

It is planned to publish volume 1, consisting of four issues, during 1957. Volume 1, number 1, is scheduled for release in June. For subscription information about both journals, write to Academic Press, Inc., 111 Fifth Ave., New York 3, N.Y.

Hungarian Scientists

Some of Hungary's best younger scientists are among the approximately 25,000 refugees who have passed through the American reception center at Camp Kilmer, N.J., in the past 2 months. Approximately 500 men and women with degrees from Hungarian universities have been screened by a National Academy of Sciences group that is led by Wallace W. Atwood, head of the academy's office of International Relations [Science 125, 187 (1 Feb. 1957)]. Many of the refugees have doctorates or have made considerable progress toward advanced degrees. The job of the screeners is to assess the qualifications of these specially trained people and find appropriate places for them in this country.

The engineers present no problems. Representatives of industry literally wait at the camp to hire them. However, other specialists, few of whom speak any English when they reach here, might well go unrecognized for a long time if they were left entirely to their own resources. But, through the work of the NAS group, some have been placed at once on staffs of universities and organizations like the Rockefeller Institute, the U.S. Department of Agriculture, and the National Institutes of Health.

The refugees, many of them former "freedom fighters," are of high caliber. Besides the graduates, there are many who have completed 2 or 3 years in Hungarian colleges. Others are expert mechanics and technicians. The college undergraduates are being screened by the World University Service, which tries to evaluate their education in our terms and secure scholarships for them.

However, the National Academy of Sciences is immediately concerned only with those who hold degrees or who have recognized professional status. Well-paid positions have been found for more than 100 people in this category. The quality

of these specialists and the efficiency of the screening process is indicated by the fact that so far there have been only two job changes. These two shifts were not caused by failure but by the refugee's desire to specialize in a certain line.

Most of the Hungarian scientists are quite young, for the average age of the escapees as a whole is only about 25. In such a group, there are of course no internationally known names. For the most part, older men of recognized distinction have remained in Hungary or have sought refuge in European countries where they have academic associations.

For the screening process it has been possible to organize a group of scientifically qualified Americans of Hungarian birth. Charlotte Ferencs of Johns Hopkins University screens the physicians and biological specialists. The former, regardless of qualifications, are difficult to place because of American laws on licensure to practice. With some, however, there has been no difficulty. One radiologist was recognized by American specialists as an outstanding man in his field. An orthopedic surgeon was a university professor until he fell afoul of the Communist regime 10 years ago. The Rockefeller Institute had a place immediately for a specialist in the chemistry of muscle. A neurophysiologist husband-and-wife team fitted into the research program of the National Institutes of Health. The same organization had a job ready for a cardiovascular physiologist.

Several in the medical group have already done part of the postgraduate work necessary to qualify as specialists. The screening committee is trying to obtain fellowships for them so that they can complete their training in this country.

One of the most colorful members of Atwood's group at Camp Kilmer is Maria Steller, a specialist in jurisprudence who escaped from Hungary years ago during the Nazi period. Since her field of interest has made it difficult for her to find an appropriate place in American life, she has a particular understanding of the problems likely to be encountered by her countrymen. Therefore, she has concerned herself with the rather large number of refugees who hold advanced degrees that are not in the physical or biological sciences. In this connection, apparently very few refugees with doctorates in literature want to come to the United States, for an international literary center is being built up in Montreal. They all want to go there where they can associate with poets, novelists, artists, and the like, from all the oppressed countries.

Nearly all the scientists among the refugees speak two or three languages with reasonable fluency; however, few

have any knowledge of English, because contact with English-speaking countries has been almost completely outside their experience. This at first appeared to be a serious placement handicap, and it was decided that no one should leave Camp Kilmer unable to carry on some kind of conversation in our native tongue.

As a result an unusual educational experiment is under way in cooperation with Rutgers University, whose campus nearly adjoins the camp. The refugees are housed in a special dormitory where they are drilled in English for 5 hours a day by Rutgers faculty members who do not know any Hungarian. The course lasts for 8 weeks, at a cost of about \$600 per person. Funds are provided by the Ford and Rockefeller foundations. After the first 4 weeks most of the students are able to conduct at least an elementary conversation.

Cellulose Research Institute

A new venture into fundamental research, a partnership between industry and the academic world, has come into being with the establishment of the Cellulose Research Institute at the State University College of Forestry at Syracuse University, Syracuse, N.Y. The director of the new institute is J. J. Hermans, professor of physical chemistry and director of the laboratory for Inorganic and Physical Chemistry at the University of Leiden, the Netherlands. Hermans is a specialist in the chemistry of macromolecular substances.

Another appointment is that of Kyosti V. Sarkanen as research associate. Sarkanen is an organic chemist who has had several years' experience in the pulp industry in Finland and with the Central Laboratory of the Finnish pulp and paper companies.

The industrial firms which, together with the College of Forestry, are the originating sponsors of the institute are the American Viscose Corporation, Philadelphia, Pa.; the Buckeye Cellulose Corporation, Memphis, Tenn.; the Celanese Corporation of America, New York, N.Y.; and the Hercules Powder Company, Wilmington, Del.

The primary objective of the unit is to provide a central source of fundamental knowledge that will serve as a basis for industrial development and growth. The institute's program will be devoted to basic research related to cellulose. All research results will be published.

The institute will also be a source of research personnel interested in chemistry and related fields. Advanced degree candidates will be affiliated with the institute and will carry out investigations under the guidance of its staff and according to the graduate requirements of

the College of Forestry. The institute will also promote conferences, seminars, and forums.

The new organization will be housed in the Hugh P. Baker Memorial Wood Products Laboratory building of the college, which has just been completed at a cost of nearly \$4 million. This modern laboratory, which is to be dedicated 2-3 May, will have numerous rooms equipped for organic and physical chemical studies of cellulose, wood, and polymers. Membership in the institute is open to all companies manufacturing cellulose products such as rayon, film, lacquers, plastics, and so forth, as well as companies making chemical pulps, and all other companies interested in research on cellulose.

Powder Diffraction, a Note to Authors

When authors submit for publication papers that describe investigations in which x-ray powder measurements were made, but which omit the actual x-ray data, it is requested that these data be sent to the editor of the Joint Committee on Chemical Analysis by Powder Diffraction Methods for possible inclusion in the *X-ray Powder Data File* that is published by the American Society for Testing Materials.

The data should contain accurate listings of *d* values and intensities of reflections. Other items of information of value for the data file are: *hkl* indices and lattice parameters if known, radiation used, type of x-ray recording employed, method of estimating intensities (visual, photometric, Geiger-counter), plus any relevant information concerning the nature and preparation of specimens studies. For additional details, communicate with the editor of the Data File, G. W. Brindley, College of Mineral Industries, Pennsylvania State University, University Park, Pa., U.S.A.

Japanese Protesting British Tests

A public debate is being held in Tokyo, Japan, on whether to send a "suicide sitdown fleet" to the forbidden waters around Christmas Island, the site of the forthcoming British hydrogen bomb tests. Premier Nobusuke Kishi and the All-Japan Seamen's Union have come out publicly against the proposed venture.

The *New York Times* reports that numerous fanatic opponents of nuclear demonstrations have offered to man small ships that would hover in the danger area. The first object of the expedition would be to prevent the British test blast, but if that failed the crusaders

would risk their lives as a protest against the development of advanced weapons.

This proposal for action against nuclear tests, made at a meeting of the Japan Council for Prohibition of Atomic and Hydrogen Bombs, has been criticized by more conservative Japanese. The idea for the protest is reported to have originated with a British pacifist journal called *Peace News*. The magazine is said to have written to the Japanese antibomb organization last week to state that five Britons had volunteered to take a suicide ship to the waters around Christmas Island if Japan would supply the vessel.

While the suicide fleet was being debated, the Japanese Government was reported to be preparing a third note to London, requesting advance notice of every blast, urging that "adequate measures" be taken to prevent damage and casualties, and asking that compensation be paid for any damage or casualties suffered by the Japanese.

Previous Japanese notes have asked the British to call off the tests. Japanese fishing interests have protested strongly that the exclusion of their ships from the waters around Christmas Island for the 5-month period of the tests will cost millions of dollars to the marlin and tuna industries. They demand compensation.

Chromosome Count

Confirmation of the previously noticed revision of the count of human chromosome numbers [*Science* 124, 576 (28 Sept. 1956)] has not been long in forthcoming. On 10 Nov. 1956, *Nature* carried an article by C. E. Ford and J. L. Hamerton reporting extensive studies carried out on testis tissue from three adult males. Very clear spermatogonial and spermatocytic counts showed 23 bivalents (or 46 chromosomes) in all but 14 among 188 cells. In those few cells one or more chromosomes had apparently been lost. No counts of 48 chromosomes, the formerly accepted number, were found.

It was noted that the two sex chromosomes, X and Y, were terminally associated in the great majority of cells, but in one cell they were held together by a subterminal chiasma. For the totality of chromosomes, an average of 55.9 chiasmata per cell, or between one and two chiasmata per chromosome pair, were observed at late diplotene to mid-diakinesis. The total amount of genetic recombination by crossing over can consequently be estimated to be half again as much as in the mouse, although it must be stated that the present data apply only to middle-aged and elderly males. Ford and Hamerton, who presented these studies at the first International Congress

of Human Genetics in Copenhagen last summer, believe that the formerly accepted number of 48 was arrived at because of some exceptionally long centric constrictions in certain chromosomes, which may have led them to be counted doubly; or else because in spermatocytes the X and Y chromosomes may have disjoined precociously, so that 24 instead of 23 bodies were counted.

Meanwhile verbal communication has come from Japan that M. Kodani has found various numbers in different individuals or in different tissues. Additional studies will be required before the question is finally resolved.—B. G.

Wisconsin's Bardeen Laboratories

The University of Wisconsin Medical School will dedicate the Bardeen Medical Laboratories on 17 May. This unit, named for Charles Bardeen, first dean of the Wisconsin Medical School, will afford space for the department of anatomy and physiological chemistry. The entire top floor will contain animal quarters. Speakers for the dedication, which will coincide with Alumni Day, will include Eugene Opie, George Corner, and Willard Rappleye.

Proposed Legislation

From 3 Jan. through 24 Feb., 1532 bills and resolutions were introduced in the Senate and 5809 in the House. Some of these have a special relevance to science and education. A list of such measures follows:

HR 783. Authorize and direct Secretary of Interior to undertake continuing studies of effects of insecticides, herbicides, and fungicides upon fish and wildlife for purpose of preventing losses of those natural resources. Metcalf (D Mont.) House Merchant Marine and Fisheries.

S 511. Establish deferred grazing program and protein feed program as parts of relief available to drought-stricken areas under P.L. 875, 81st Congress. Johnson (D Tex.) Senate Agriculture and Forestry.

HR 1080. Provide for standards to be prescribed by Secretary of Agriculture governing imported agricultural food products. Byrnes (R Wis.) House Agriculture.

HR 1107. Provide for emergency federal financial assistance to states and territories in construction of public elementary- and secondary-school facilities urgently needed because of overcrowding, and encourage full and efficient use of state and local resources in meeting school-construction needs. Donohue (D Mass.) House Education and Labor.

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HR 1073. Protect the public health by regulating manufacture, compounding, processing, distribution, and possession of habit-forming barbiturate and amphetamine drugs. Boggs (D La.) House Interstate and Foreign Commerce.

HR 2498. Same as HR 1073. Sadlak (R Conn.) House Interstate and Foreign Commerce.

HR 1055. Provide for establishment of U.S. Armed Forces Medical Academy. Bennett (D Fla.) House Armed Services.

HR 935. Preserve permanently as a national park an area of national significance in Colorado and Utah, such park to be known as Dinosaur National Park, which shall supersede Dinosaur National Monument. Saylor (R. Pa.) House Interior and Insular Affairs.

HR 906. Establish on public lands of U.S. a National Wilderness Preservation System. Reuss (D Wis.) House Interior and Insular Affairs.

HR 965. Promote and establish policy and procedure for development of water resources of lakes, rivers, and streams. Trimble (D Ark.) House Public Works.

HR 1058. Preserve key deer and other wildlife resources in Florida Keys by establishment of National Key Deer Refuge in Florida. Bennett (D Fla.) House Merchant Marine and Fisheries.

HR 847. Provide for more comprehensive development and utilization of natural water resources in plans and construction of reservoir projects. Natcher (D Ky.) House Public Works.

HR 866. Authorize President to make permanent replacements of public facilities and public and private school buildings damaged or destroyed in major disaster. Philbin (D Mass.) House Public Works.

S 432. Allow additional income tax exemptions for taxpayer or spouse or dependent child under 23 years of age, who is full-time student at educational institution above secondary level. Fulbright (D Ark.) Senate Finance.

HR 1082. Encourage prevention of air and water pollution by allowing cost of treatment works for abatement of air and stream pollution to be amortized at accelerated rate for income tax purposes. Byrnes (R Wis.) House Ways and Means.

HR 1245 Establish policy of Congress *re* public use of public domain forest lands and woodlands. Saylor (R Pa.) House Interior and Insular Affairs.

HR 1227. Provide research and technical assistance *re* control of salt-marsh and other pest mosquitoes of public health importance and mosquito vectors of human disease. Rivers (D S.C.) House Interstate and Foreign Commerce.

HR 1235. Authorize and request

President to undertake to mobilize at some convenient place in U.S. adequate number of world's outstanding experts and coordinate and utilize their services in supreme endeavor to discover means of curing and preventing cancer. Rooney (D N.Y.) House Foreign Affairs.

HR 2213. Reorganize civil defense functions of Federal Government, establish federal Department of Civil Defense. Fascell (D Fla.) House Government Operations.

HR 2220. Establish Medical Advisory Committee on Alcoholism in Department of Health, Education, and Welfare. Huddleston (D Ala.) House Interstate and Foreign Committee.

H J Res 85. Provide U.S. shall withhold from representatives of foreign nations privileges which such nations withhold from representatives of U.S. Rivers (D S.C.) House Foreign Affairs.

H J Res 99. Establish joint Congressional committee known as Joint Committee on U.S. International Exchange of Persons Program. Scott (R Pa.) House Rules.

H J Res 102. Provide for construction of nuclear power reactor in Japan. Smith (D Miss.) Atomic Energy.

H J Res 30. Establish Commission on Utilization of Manpower in U.S. Dollinger (D N.Y.) House Education and Labor.

HR 2178. Authorize appointment of doctors of chiropractic in Department of Medicine and Surgery of Veterans' Administration. Rogers (R Mass.) House Veterans' Affairs.

H J Res 5. Provide for observance and commemoration of 50th anniversary of founding and launching of conservation movement for preservation of natural resources of U.S. Celler (D N.Y.) House Judiciary.

H Res 43. Create select committee to conduct investigation and study of hurricane and flood control and warning problems. Keating (R N.Y.) House Rules.

H J Res 23. Provide for reappointment of Dr. Arthur H. Compton as Citizen Regent of Board of Regents of Smithsonian Institution. Cannon (D Mo.) House Administration.

HR 1240. Provide for certain inspection and investigation in metallic and nonmetallic mines (excluding coal and lignite mines) in obtaining information *re* health and safety conditions, accidents, and occupational diseases. Saylor (R Pa.) House Education and Labor.

HR 2154. Provide for a civilian atomic power acceleration program. Holdfield (D Calif.) House Atomic Energy.

H J Res 32 Establish Northeastern United States Watershed Development and Flood Protection Commission. Donohue (D Mass.) House Public Works.

HR 1268. Authorize comprehensive project for control and progressive eradication of obnoxious aquatic plant growths from navigable waters. Willis (D La.) House Public Works.

S 575. Provide for establishment of four soil- and water-conservation laboratories. Thye (R Minn.) Senate Agriculture and Forestry.

S 608. Establish national grazing reserve by providing assistance to livestock producers who carry out certain range-conserving practices on privately owned grazing lands or on grazing lands under jurisdiction of Forest Service or Bureau of Land Management. Watkins (R Utah) Senate Agriculture and Forestry.

HR 1980. Establish public use of national forests as policy of Congress. Price (D Ill.) House Agriculture.

HR 1211. Authorize Secretary of Health, Education, and Welfare to make loans to assist students in pursuing courses at colleges and universities in U.S. Poage (D Texas) House Education and Labor.

HR 1946. Authorize federal payments to states to assist in constructing schools. Kearns (R Pa.) House Education and Labor.

HR 1961. Assist several states in providing scholarships to enable high-school graduates of Indian blood to pursue education at colleges and universities. Metcalf (D Mont.) House Interior and Insular Affairs.

HR 1976. Provide system of scholarships for persons of unusual ability in certain sciences. Osmers (R N.J.) House Education and Labor.

HR 2450. Amend National Science Foundation Act of 1950 to encourage training of additional engineers and expansion of facilities for engineering education by providing supplementary salary grants for engineering teachers and scholarships and fellowships for engineering students. Holland (D Pa.) House Interstate and Foreign Commerce.

HR 2413. Promote progress of medicine and advance national health and welfare by creating a National Library of Medicine located in Chicago, Ill. Collier (R Ill.) House Administration.

S 539. Direct Secretary of State and Secretary of Interior through Bureau of Reclamation to study economic and engineering feasibility of acquiring riparian rights from Republic of Mexico to water in Gulf of California for piping and pumping of water from Gulf of California to Arizona for irrigation purposes. Goldwater (R Ariz.) Senate Foreign Relations.

HR 2008. Establish system for classification and compensation of scientific and professional positions in government. Huddleston (D Ala.) House Post Office and Civil Service.

S Res 38. Provide until 31 Mar. 1957

for study of administration of government employees security program. Johnston (D S.C.) Senate Post Office and Civil Service.

HR 1945. Provide for establishment of Federal Advisory Council on the Arts. Kearns (R Pa.) House Education and Labor.

HR 2435. Provide a Federal Advisory Council of Health in Executive Office of President in accordance with recommendations of Commission on Organization of Executive Branch of Government. Frelinghuysen (R N.J.) House Interstate and Foreign Commerce.

HR 2419. Provide that one floating ocean station be maintained at all times in Gulf of Mexico to provide storm warnings for states bordering Gulf of Mexico. Colmer (D Miss.) House Merchant Marine and Fisheries.

HR 2378. Designate building to be constructed as principal office of Atomic Energy Commission under act of 6 May 1955, as "Enrico Fermi Building," to provide for establishment of appropriate memorial to Dr. Fermi. Addonizio (D N.J.) House Atomic Energy.

HR 2451. Authorize Secretary of Interior to conduct cloud-seeding experiments in Colorado River Basin. Hosmer (R Calif.) House Interior and Insular Affairs.

S 555. Authorize construction, operation, and maintenance of Hells Canyon Dam on Snake River between Idaho and Oregon. Morse (D Ore.), Magnuson (D Wash.) *et al.* Senate Interior and Insular Affairs.

Scientists in the News

CARL-GUSTAV ROSSBY, director of the Institute of Meteorology, University of Stockholm, has been appointed visiting professor of meteorology at the department of meteorology, University of California, Los Angeles, for the period 4 Mar.-10 Apr. During his visit Rossby will deliver a series of lectures on the scope of modern meteorology, giving examples ranging from the central topics of classical meteorology to the newest territories to which meteorological research has led.

ARTHUR G. STEINBERG, formerly of the Children's Medical Center, Boston, Mass., is now professor of biology at Western Reserve University.

EDWARD TELLER, professor of physics and associate director of the Radiation Laboratory at the University of California, Berkeley, has received Dickinson College's Priestley memorial award. The award, a Wedgwood portrait medallion of Joseph Priestley and \$1000, is con-

firmed each year upon a scientist for research or discovery that is of benefit to mankind.

CORNEILLE HEYMANS, professor of pharmacology at the University of Ghent, Belgium, and 1938 Nobel prize winner, delivered Georgetown University's 1957 Raskob lecture on 4 Mar. His subject was "Regulation of blood pressure and hypertension."

LAWRENCE E. YOUNG will succeed WILLIAM S. McCANN as Charles A. Dewey professor of medicine and chairman of the department at the University of Rochester Medical School, effective 1 July. Young, a member of the faculty since 1943, also will be physician-in-chief of Strong Memorial Hospital, teaching hospital of the medical school. McCann will become professor emeritus 1 July.

OSCAR TOUSTER, associate professor of biochemistry at Vanderbilt Medical School and winner of last year's AAAS Theobald Smith award, will participate in a series of seminars with research personnel of the Samuel Roberts Noble Foundation, Inc., Ardmore, Okla., 28-30 Mar. The principal area of discussion will be cell metabolism of both normal and malignant cells. Culminating these talks, Touster will speak before a group of Noble personnel and invited guests from Oklahoma and Texas.

HAROLD H. BEVERAGE, vice president, RCA Communications, Inc., and director of the Radio Research Laboratory's RCA Laboratories, has been awarded the 1956 Lamme gold medal of the American Institute of Electrical Engineers. Presentation of the medal will take place on 24 June during the summer general meeting of AIEE in Montreal. Beverage is being honored "for his pioneering and outstanding engineering achievements in the conception and application of principles basic to progress in national and world-wide radio communications."

EDWARD E. SWANSON, head of Eli Lilly and Company's bio-assay department, ended nearly 40 years of service at Lilly when he retired on 31 Jan. Swanson is the author or coauthor of more than 75 papers dealing with the pharmacology of such drugs as digitalis, the barbiturates, and vasoconstrictors. He contributed to the development of insulin and, more recently, has done important work on curarelike substances. In 1955, when he received an honorary degree from Butler University, the citation referred to him as "a noted Pharmacist and renowned Pharmacologist who

has made exceptional contribution to both professions and one whose researches have benefited all mankind."

The State University of Iowa gave Swanson a degree as pharmaceutical chemist in 1916 and a bachelor of science degree in pharmacy in 1917. He has done graduate work at both the University of Wisconsin and Butler. In 1928 he received the American Pharmaceutical Association's Ebert medal, the highest scientific honor bestowed in American pharmacy, for his research in digitalis.

Since 1929 Swanson has lectured on bio-assay and pharmacology as a member of the faculty of the Butler University College of Pharmacy. He plans to continue teaching at Butler.

VERGIL M. McINTOSH has been named as associate professor of psychology by the Air University, Maxwell Air Force Base, Ala. Announcement of the academic title was made by Headquarters, Air Force ROTC, where McIntosh is employed in the education branch.

Recent Deaths

HERBERT E. ARNOLD, Durham, Conn.; 60; professor of mathematics at Wesleyan University; 2 Mar.

GEORGE L. DRESSER, Albany, N.Y.; 71; civil engineer; 25 Feb.

EMIL C. FANTO, Manhasset, N.Y.; 82; retired assistant secretary and research director of McKesson and Robbins, Inc.; 22 Feb.

TOWNSEND B. FRIEDMAN, Chicago, Ill.; 51; permanent chairman of the Michael Reese Hospital and Children's Memorial Hospital departments of allergy; 6 Mar.

GEORGE GOMORI, Palo Alto, Calif.; 52; president of the Histochemical Society; former professor of medicine at the University of Chicago School of Medicine; 28 Feb.

ALFRED GROSS, New Haven, Conn.; 64; associate clinical professor of psychiatry at Yale University; 1 Mar.

ERIC A. LOF, New Rochelle, N.Y.; 77; retired electrical and chemical engineer formerly with General Electric Company and American Cyanamid Company; 6 Mar.

ROBERT H. MAYO, London, England; 66; aeronautical engineer, inventor of the pickaback plane; 26 Feb.

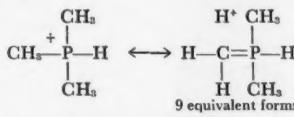
JOHANN O. PLESCH, Los Angeles, Calif., and Montreux, Switzerland; 78; retired professor of medicine at the University of Berlin; 28 Feb.

Erratum: In reference 5 of "Eastern equine encephalomyelitis virus isolated from three species of Diptera from Georgia," by L. H. Karstad *et al.* [Science 125, 396 (1 Mar. 1957)], the name of J. E. McCroan is incorrectly spelled as Croan.

Reports

Effect of Hyperconjugation on Strength of Lewis Bases

The effect on the base strength of substituting methyl groups for hydrogen on nitrogen is an increase of the order of 100-fold in K_b in going from ammonia to trimethylamine (1). In going from phosphine to trimethylphosphine (2), there is an increase in K_b of the order of 10²⁰. This enormous difference in the effect of a methyl group on the basicity of phosphines compared with amines must be attributed to a type of interaction with a methyl group which is possible with phosphorus but not with nitrogen. Hyperconjugation involving the hydrogens attached to the methyl groups and the empty d -orbitals of phosphorus provides a possible answer (3). Thus, there are nine equivalent contributing structures that would reduce the positive charge on the phosphorus atom and thereby stabilize the trimethylphosphonium ion.

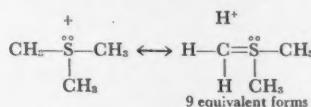


An effect such as this, if present in phosphorus alkyls, might reasonably be expected to be operative in alkyl derivatives of other elements having low-lying vacant orbitals when these elements also carry a formal positive charge. The stabilization of the tertiary butyl carbonium ion by hyperconjugation is an effect well known to organic chemists and need not be discussed here.

Comparison of the basicity of dimethylether and dimethylsulfide toward protonic acids is difficult because of the

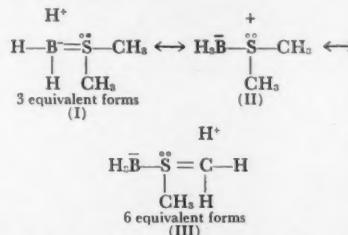
All technical papers and comments on them are published in this section. Manuscripts should be typed double-spaced and be submitted in duplicate. In length, they should be limited to the equivalent of 1200 words; this includes the space occupied by illustrative or tabular material, references and notes, and the author(s)' name(s) and affiliation(s). Illustrative material should be limited to one table or one figure. All explanatory notes, including acknowledgments and authorization for publication, and literature references are to be numbered consecutively, keyed into the text proper, and placed at the end of the article under the heading "References and Notes." For fuller details see "Suggestions to Contributors" in *Science* 125, 16 (4 Jan. 1957).

rearrangement of the sulfide to sulfonyl ion in acid solution (4). However, the stability of trimethylsulfonium iodide compared with that of the corresponding oxygen compound (4) strongly supports the proposed interaction.



The stability of selenonium and telluronium alkyls (4) may be attributed to the same type of interaction.

The trimethylsulfonium ion is isoelectronic with the addition compound dimethylsulfide-borine, for which an interaction of the borine group with the empty d -orbital of sulfur has been proposed by Graham and Stone to account for its stability relative to the oxygen compound (5). These authors, however, did not point out the possible stabilization due to hyperconjugation with the methyl groups.



It is not to be implied that structure III is twice as important as structure I since there is greater charge separation in III, but it is felt that structure III will make a significant contribution. The idea that methyl hyperconjugation may be important even when borine groups are present is supported by the large effect of methyl groups on the stability of the arsine-borine compounds (6). Hyperconjugation involving the hydrogen attached to the boron has also been proposed in the polymeric arsine-borine compounds to account for the decreased hydridic character of the hydrogen (6).

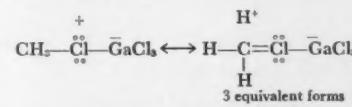
It would appear desirable to check the assumption of hyperconjugation in these systems by replacing the methyl groups with ethyl, isopropyl, and tertiary butyl

groups where hyperconjugation should make a successively decreasing contribution. However, studies on such a series might be complicated by steric factors. Thus the rate constants for the reaction of methyl-, ethyl-, propyl, isopropyl, butyl, isobutyl, and tertiarybutylthioglycolic acid with iodoacetic acid have been determined (7) and might be interpreted in terms of hyperconjugation, but the data may be interpreted equally well in terms of B- and F-strain (8). The observation that dihalogenides are readily formed from sulfides in which the sulfur atom is attached to a methyl or methylene group (9) supports the hyperconjugation view, but unfortunately the only data on tertiary substituents were for diaromatic sulfides in which resonance with the aromatic might lower the reactivity of the sulfur.

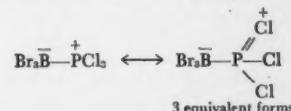


where X is Br or I.

A study has been made on the interaction of the alkyl chlorides with gallium chloride indicating that the order of stabilities is methyl > ethyl > isopropyl > tertiary butyl, but the results may be affected, as pointed out by the original authors, by crystal lattice forces and the formation of several species of complexes (10). Steric factors should be of less importance here than in the group V and VI compounds, and accordingly the data support the view of hyperconjugation in these compounds.



Thus far we have considered only hyperconjugation with empty d -orbitals, but other types of conjugations may also be important. Thus the basic properties of the phosphorus trihalides (11) may be explained by π -bonding involving the halogen attached to the phosphorus.



Evidence supporting the existence of π -bonding in four coordinated phosphorus compounds has recently been published (12). The observation was made that π -bonding is of greater importance in four-coordinated phosphorus than in compounds of other coordination number. This is undoubtedly due to the formal positive charge that would be placed on phosphorus if only σ -bonds were present in the four-coordinated state. Since a formal positive charge would be present on the central atom

whenever the compounds of the group V, VI and VII elements act as Lewis bases, π -bonding should be an important factor in the base strength of these compounds.

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References and Notes

- There is a slight irregularity in the amine family, the tertiary amines being less basic than the secondary amines. This anomaly has been explained by H. C. Brown, H. Bartholomay, and M. D. Taylor in terms of B-strain [*J. Am. Chem. Soc.* 66, 435 (1944)] and by R. G. Pearson and F. V. Williams in terms of solvation effects [*J. Am. Chem. Soc.* 76, 258 (1954)].
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- See J. H. Gibbs for an alternative explanation [*J. Chem. Phys.* 22, 1460 (1954)].
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12 December 1956

Distribution of Calcium in Adult *Drosophila melanogaster*

It has been shown by Levine (1) that the amount of crossing over observed in females of *Drosophila melanogaster* can be decreased by feeding adults on medium containing increased amounts of calcium. Similar effects are produced if the females are desiccated during pupal life. On the other hand, crossing over is increased if the females are fed during larval life on a medium containing the chelating agent, ethylenediaminetetraacetic acid. To explain these results, Levine postulated that calcium normally plays a role in the nuclei of *D. melanogaster* and that this role is to "stabilize" the chromosomes. Therefore, if the cellular calcium concentration is increased by feeding the fly extra calcium or by decreasing the water content of the cells by desiccation, the chromosomes are "stabilized" and show less crossing over. Conversely, if the calcium content is decreased by administering a chelating agent, then the chromosomes become "unstable" and show increased amounts of crossing over.

However, it is hard to reconcile this theory with certain information that is available concerning the calcium requirements of *D. melanogaster*. It is known, for example, that if calcium is required by *D. melanogaster* at all, it is necessary only in minute quantities (2). Furthermore, Yasuzumi and Sawada (3) have shown that, whereas calcium is present in the cytoplasm of the larval salivary gland cells of *D. virilis*, it is apparently absent in the chromosomes, and Poulsen and Bowen (4), utilizing radiocalcium, found no evidence for nuclear localization of calcium in larvae of *D. repleta*. In addition, Poulsen and Bowen state that "the rapid transfer of the element to storage areas of the malpighian tubules contraindicates the existence of any major calcium component in tissues generally."

The results of our autoradiographic studies (5) of Ca^{45} -localization in adult *D. melanogaster* are in complete agreement with the statement of Poulsen and Bowen. Flies of the Oregon-R strain were fed during the larval and adult stages on *Saccharomyces cerevisiae* homogeneously labeled with Ca^{45} . Autoradiograms of adults showed Ca^{45} to be homogeneously distributed in the blood and tissue fluids and concentrated only in the terminal portions of the anterior malpighian tubules. Developed grains were equally abundant whether above the nuclei or the cytoplasm of the cells making up various tissues. There was no concentration of calcium in oocyte nuclei or sperm heads. The calcium content of the adults was 165 ppm. Males and females did not differ significantly with respect to the distribution of calcium. The distribution of calcium from yeast ingested during adult and larval stages was as follows: head, 0.131; thorax, 0.141; legs, 0.051; wings, 0.024; gut, 0.084; reproductive system, 0.037; malpighian tubules, 0.109; abdominal residue, 0.066; and liquid residue (mainly hemolymph), 0.357 (for adult flies 0 to 1 day old).

We conclude (i) that *Drosophila melanogaster* requires at most trace amounts of calcium, (ii) that the majority of the calcium taken in is rapidly transferred to and stored in the excretory organ of the insect, and (iii) that calcium is not required as a component of chromosomes in concentrations higher than those found in the cytoplasm and body fluids.

It follows that, if calcium plays a role in "stabilizing" the chromosomes of *D. melanogaster*, then extremely small amounts are required. It is difficult to see under these conditions why adding more calcium to the standard medium should have any effect. It also seems unlikely that ethylenediaminetetraacetic

acid can reduce the available calcium in the standard medium below the traces in which it is required.

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- This work was supported by the U.S. Atomic Energy Commission.

10 January 1957

Purification of Poliovirus with Fluorocarbon

When we were searching for a procedure for removing protein from crude viral suspensions, the report of Gessler *et al.* (1) came to our attention. Gessler *et al.* have described a procedure for the purification of vaccinia and Rous sarcoma virus in which infected tissues are homogenized in a high speed blender with a fluorocarbon mixture. On separation of the two phases, it was found that nonviral protein was removed from the aqueous layer, whereas the virus remained in it. This communication (2) reports results following the application of a similar procedure to the purification of poliomyelitis virus, type II, strain MEF-1, that was grown in a culture of HeLa cells.

The medium used for propagation of

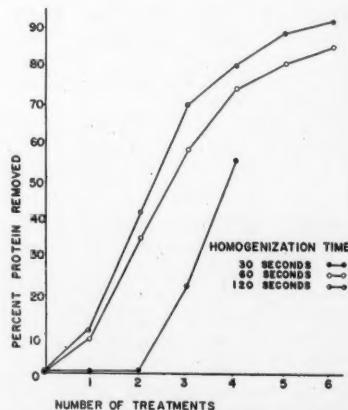


Fig. 1. Protein removal by fluorocarbon treatment.



Fig. 2. (Top) Crude suspension of poliovirus, type II, strain MEF-1 ($\times 18,400$). (Bottom) Poliovirus, type II, strain MEF-1, purified by one fluorocarbon treatment ($\times 18,400$).

the host tissue was Eagle's basal medium (3) to which human serum was added to a final concentration of 10 percent. The following method was employed in the purification procedure. All operations with infectious materials were carried out in a hood equipped with an exhaust system. Freon 112, 1,2 difluorotetrachloroethane (4), was dissolved in *n*-heptane to yield a solution with a specific gravity of 1.30. Equal volumes of aqueous virus suspension and fluorocarbon solutions, both cooled to 4°C , were then blended at top speed (14,500 rev/min) in a Servall Omnimixer. The blending chamber was immersed in an ice bath during the homogenization. The chamber was then allowed to stand undisturbed for 10 minutes to allow any aerosols that might have developed to settle. The homogenate was centrifuged for 10 minutes at 1000*g* and was found to have separated into three layers. Uppermost was a clear aqueous layer containing the virus; at the bottom was the clear fluorocarbon mixture; the protein accumulated at the interface.

It is possible to remove 90 percent of

the protein by repeatedly treating a sample of growth medium with the fluorocarbon mixture. In Fig. 1 are shown the effects of repeated homogenizations, as well as the effects of various times of homogenization, on the protein content of the aqueous phase. Protein was determined by the method of Lowry *et al.* (5). Since homogenization for as long as 10 minutes did not increase the efficiency of a single extraction, blending for 1 to 2 minutes was adopted as a routine procedure. However, an increase in the ratio of fluorocarbon mixture to aqueous suspension did increase the efficiency of extraction in one instance: in this experiment, a ratio of 10/1 was used, and almost 50 percent of the protein was removed in one step.

The residual concentrations of infectious virus were determined after successive fluorocarbon treatments had increased the purity of the viral material. In one typical experiment, 200 ml of crude poliovirus suspension containing $10^{6.50}$ tissue-culture infectious doses (6) were subjected to six successive fluorocarbon treatments. A sample of the supernatant fluid from each treatment was assayed for viral content. Tenfold serial dilutions were made in growth medium in which calf serum was substituted for human serum. One-milliliter aliquots of each dilution were inoculated into each of four tubes containing HeLa cells. After three days' incubation at 37°C , the presence or absence of virus was determined by observing whether or not the sheet of cells had disintegrated. The supernatant fluids obtained after each of the six successive treatments titered $10^{6.25}$, $10^{6.50}$, $10^{6.25}$, $10^{5.75}$, $10^{4.75}$, and $10^{4.75}$, respectively. Thus there was no significant decrease in titer until after three successive treatments.

Electron photomicrographs (7) of the supernatant fluids of cultures of strain HeLa cells that were infected with poliovirus before and after one fluorocarbon treatment (Fig. 2) show that one such treatment removes nonviral components to such a degree that viral particles can be readily distinguished.

This purification procedure was subsequently applied successfully to other viral suspensions; coliphage T5; poliovirus, types 1 and 3; feline pneumonitis virus; and certain members of the adenovirus group. By the same means, Hummeler and Hamparian (8), report that anticomplementary activity and host antigens are removed from poliomyelitis antigens derived from tissue culture. Werner (9) reports the purification of some adenovirus types by the fluorocarbon method. The foregoing method seems to have great applicability and shows promise of providing a relatively simple way of removing protein from

viral suspensions without materially affecting the virus particle. Further work to assess the scope of usefulness of this procedure is being carried out in our laboratory (10).

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7. We should like to express our appreciation to N. Coy and J. Oskay of the Squibb Institute for Medical Research, New Brunswick, N.J., for kindly extending to us the use of their facilities for electron microscopy.
8. K. Hummeler and V. Hamparian, *Science*, this issue.
9. G. H. Werner, personal communication.
10. We are indebted to Mary Wick for her invaluable technical assistance. This work was aided by a grant from the National Foundation for Infantile Paralysis.

27 November 1956

Removal of Anticomplementary Activity and Host Antigens from Viral Preparations by Fluorocarbon

Complement-fixing antigens derived from tissue cultures of HeLa or monkey renal cells infected with poliomyelitis or other viruses may reveal anticomplementary activity that renders them unsuitable. Since such preparations also regularly contain host materials, the specific reactions can be analyzed and standardized only with serums free of antibodies to host antigens. Gessler *et al.* (1) recently described a simple method of segregating virus from tissue homogenates by deproteinization with fluorocarbons. The virus particles remain in the aqueous phase, while proteins are retained in the organic phase. This technique has been applied successfully to removal of anticomplementary activity and of host antigens from infected tissue-culture preparations, without impairment of specific reactions (2).

Fluorocarbon Freon 112 (3) was adjusted to a specific gravity of 1.30 by admixture of *n*-heptane (1). Bottle cultures of HeLa or monkey renal cells infected with poliomyelitis viruses were harvested when the cell-sheets were completely destroyed. The culture fluids were treated without prior removal of the cell debris. Initially, 1 part of fluorocarbon-

heptane mixture to 2 parts of tissue-culture material was used. Since it was the aim, however, to remove undesirable reactivities and not to attain a high degree of purification of the viruses, the smallest amount of the fluorocarbon-heptane mixture was used that would serve this purpose—that is, 1 part per 10 parts of the tissue-culture material.

The virus-fluorocarbon mixtures were homogenized in a Servall Omnimixer at 14,500 rev/min for 3 to 4 minutes while the treatment vessels were submerged in ice. The homogenates were centrifuged at 1000 rev/min for 5 to 10 minutes to separate the aqueous from the organic layers. The aqueous phase revealed little, if any, loss of infectivity, as was observed also by Manson *et al.* (4). Complement-fixation tests were performed by the standard technique employed in our laboratory (5).

Table 1. Removal of anticomplementary activity by fluorocarbon without loss of specific antigens. *a*, Antigen anticomplementary; no specific reaction obtained. All titers are expressed as the reciprocal of the highest serum dilution that reacted with the given concentrations of antigen.

Poliomyelitis antigens		Untreated antigens			Treated antigens		
		Antipoliomyelitis serum type		Saline control	Antipoliomyelitis serum type		Saline control
Type	Diln.	I	II	III	I	II	III
I	1/1	4	a	a	0	128	< 32
I	1/2	4	a	a	0	64	
I	1/4	3	a	a	0	32	
I	1/8	0	< 32	< 32	0	< 32	
II	1/1	4	a	a	0	256	< 32
II	1/2	4	a	a	0	256	
II	1/4	2	a	a	0	128	
II	1/8	0	< 32	< 32	0	< 32	
III	1/1	4	a	a	0	< 32	256
III	1/2	4	a	a	0	256	
III	1/4	3	a	a	0	128	
III	1/8	±	a	a	0	< 32	
I	1/1	0	256	< 32	0	256	< 32
I	1/2	0	128		0	128	
I	1/4	0	64		0	64	
I	1/8	0	< 32		0	< 32	

Table 2. Removal of host antigen by fluorocarbon. All titers are expressed as the reciprocal of the highest serum dilution that reacted with the given concentration of antigen.

Antigens	Virus	Treated	Guinea pig serums		
			Versus poliomyelitis (HeLa) type		
			I	II	III
Poliomyelitis type I (monkey renal cells)	—		128	< 16	< 16
Poliomyelitis type I (HeLa cells)	—		256	64	256
Poliomyelitis type I (HeLa cells)	+		128	< 16	< 16
Coxsackie B ₅ (HeLa cells)	—		512	256	512
Coxsackie B ₅ (HeLa cells)	+		< 16	< 16	< 16
Uninoculated HeLa cells frozen and thawed	—		64	32	64
Uninoculated HeLa cells frozen and thawed	+		< 16	< 16	< 16

Table 1 summarizes the results of an experiment with poliomyelitis antigens derived from HeLa cells, using type-specific serums obtained from monkeys following immunization with viruses grown in monkey renal cells. The first three crude antigens were anticomplementary; hence, specific reactions could not be discerned. After fluorocarbon treatment, the anticomplementary effects were lost, and specific reactions were readily apparent. Exposure to fluorocarbon of crude antigens, which were not anticomplementary, failed to show a decrease in specific reactions, as is shown, for example, in the last antigen included in Table 1. Other tissue-culture antigens (adeno group and Coxsackie B) and antigens derived from chick embryo chorioallantoic membranes (herpes simplex, mumps soluble antigen) or allantoic fluids (mumps and influenza virus anti-

gens) were treated with fluorocarbon without loss in antigen titers. Anticomplementary preparations of these antigens were not available.

In the experiment shown in Table 2, serums were employed which were collected from guinea pigs after they had been immunized with poliomyelitis viruses grown in HeLa cells. The test antigens, likewise, were derived from HeLa cultures with the exception of one of the poliomyelitis type-I preparations, which was obtained from monkey renal cells. The latter reacted only with its homologous serum. All other crude antigens gave strong reactions with all of the anti-serums, clearly based on interaction of host antigens with corresponding antibodies present in the serums. Fluorocarbon treatment removed these host antigens so that thereafter only the homologous serum reacted with the type-I antigen.

The technique has made it possible to salvage anticomplementary antigens for routine diagnostic tests and to employ, where unavoidable, antiserums prepared by immunization with virus preparations of the same kind as those used for test antigens.

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27 November 1956

Ribosidation as a Means of Activating 6-Azauracil as an Inhibitor of Cell Reproduction

6-Azauracil (*as*-triazine-3,5-dione), an analog of uracil, is an inhibitor of the growth of certain microorganisms (1) and of several experimental tumors, including sarcoma 180 (S-180), in mice (2). In contrast, in tissue culture, 6-azauracil has no inhibitory activity on HeLa cells or mouse fibroblasts in the highest concentration tested (3). In addition, in our experiments with sarcoma 180 cells (in Eagle's medium containing 5 percent dialyzed horse serum, 4), 6-azauracil in concentrations as high as 5 mM, was completely inactive as an inhibitor of cell reproduction. These findings suggested that the inhibitory activity

Table 1. Inhibition of growth of sarcoma 180 by 6-azauridine in tissue culture.

Concn. of 6-azauridine (μmole/ml)	Growth as compared with control (%)
0	100
0.01	88
0.03	83
0.1	50
0.3	16

Table 2. Reversal by uridine of the inhibitory action of 6-azauridine (0.2 μmole/ml) on sarcoma 180 in tissue culture.

Concn. of uridine (μmole/ml)	Growth as compared with control (without inhibitor or uridine) (%)
0	37
0.002	59
0.006	84
0.02	94
0.06	94
0.2	96

on sarcoma-180 *in vivo* might be attributable to a metabolite of the analog formed by the liver or other normal tissues. An attractive possibility for consideration, as a metabolite of 6-azauracil, was its riboside (6-azauridine), since this derivative is formed by certain microorganisms and inhibits the growth of 6-azauracil-resistant strains that emerge when *Streptococcus faecalis* is grown in the presence of 6-azauracil (5). The 6-azauridine used was prepared both biosynthetically (using *S. faecalis* 8043) and by chemical synthesis (6, 7).

Of the sarcoma-180 cells (8), 200,000 were introduced into each culture flask (Earle's T-15) (9) in which 2 ml of Eagle's medium containing 10 percent horse serum was present (4). After 24 hours, this medium was replaced by Eagle's medium containing 5 percent dialyzed horse serum and various concentrations of 6-azauridine; the medium was renewed daily. After 7 days, the protein content of the cell layer was determined, using the method of Oyama and Eagle (10). In the controls, without inhibitor, a three- to four-fold increase in cell protein, as compared with that observed 24 hours after inoculation, was obtained. Both the biosynthetically and the chemically prepared 6-azauridine showed the same high activity in inhibiting the growth of sarcoma-180; the results obtained with the biosynthetic material are shown in Table 1.

The activity of 6-azauridine was an-

tagonized by uridine: as is shown in Table 2, the molar ratio of metabolite to antagonist necessary to abolish almost completely the action of 6-azauridine (at the level tested, 0.2 μmole/ml) was 1/10. Even with a tenfold higher concentration of uridine, under these conditions, no evidence of toxic effects on the cells was observed. Deoxyuridine was also active in reducing the inhibitory activity of 6-azauridine; however, quantitative data concerning its activity and its possible toxicity for the cells have not yet been obtained. Further work will be concerned with the action of related analogs and their nucleosides, the effects of other possible reversing agents and their comparative activity, and the effects of the agents on other cell lines in tissue culture (11).

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Tungsten Microelectrode for Recording from Single Units

An electrode has been developed to fill the need for an easily made, sturdy device capable of resolving single-neuron action potentials at least as well as the commonly used micro-pipette. It was designed to be used not only in acute animal experiments in the central nervous system, but also in cases where pipettes may be especially prone to break, such as in chronic unrestrained preparations, with muscle, and in the human being during neurosurgical pro-

cedures. Early experience made it clear that, while tip diameters of the order of 20 μ may at times be adequate for resolution of unitary spikes recorded extracellularly, tips 5 μ or less are much more satisfactory, and that intracellular recording usually demands tips of less than 1 μ in diameter. Since steel wire becomes too fragile near the tip when thus sharpened and also requires too thick a shaft, tungsten was selected as by far the stiffer, easily available metal.

The electrode consists of an electrolytically sharpened tungsten wire insulated to the tip with a suitable lacquer. A wire 125 μ (5 mils) in diameter and about 1 inch long is bent slightly near one end which is then mounted in a 27-gage hypodermic needle. Because crimping of these needles results in perfectly satisfactory electric contact, no attempt has been made to solder the tungsten. Electropolishing is then carried out by a method analogous to that described by Grundfest *et al.* (1) for steel: the terminal few millimeters are immersed in a saturated aqueous potassium nitrite (KNO_3) solution, and an alternating current is passed between the wire and a nearby carbon rod, using 2 to 6 v, which may be conveniently obtained from a 6.3-v filament transformer fed by a Variac (2). The optimum voltage is not critical, but currents that are too low or too high tend to cause pitting.

If the wire is kept stationary and if the polishing is allowed to continue until all bubbling ceases, a rather abrupt pencil-like point is obtained which has a tip of ultramicroscopic dimensions (from 0.5 to 0.05 μ in diameter). Such a result is explained by the fact that the meniscus height depends on the diameter of the wire, which decreases as the polishing proceeds. The suddenness of the taper may give rise to excessive dimpling of the tissue to be penetrated. This may be avoided by lowering and raising the wire during all but the final stages of polishing, thus producing almost any degree of taper. A hydraulic drive with two oil-filled syringes and plastic tubing may be used for this, as well as for the coating.

Fig. 1A shows an electromicrograph of a wire sharpened as described; the tip measures about 0.4 μ. Tips of this size or less are consistently obtained without particular skill or practice.

Sharpened electrodes are washed in detergent and coated with a clear lacquer (3) that has been allowed to thicken to an almost honeylike consistency by exposing to air at room temperature for some hours. Under a dissecting microscope (6 to 40 magnifications), the wire is lowered into a beaker brimful of freshly stirred lacquer, and then slowly raised. When the tip

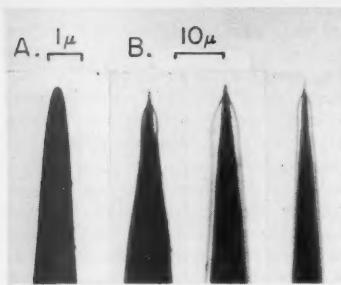


Fig. 1. (A) Electromicrograph of an uncoated, sharpened tungsten wire; (B) optical photomicrographs of coated electrodes immersed in water to show the coating.

emerges and lacquer runs up from the tip, the tip is quickly redipped up to the bead so formed, and this is repeated until the lacquer no longer runs up. The receptacle must be full and preferably small, and it must be used in a region where air is circulating to prevent thinner vapor from condensing on the tip and washing off the coating. The electrode is allowed to dry for 24 hours; it need not be baked.

Coarse testing is carried out by watching bubbling under the microscope when direct current is passed through the electrode in 0.9-percent NaCl solution using 6 to 12 v (electrode negative). This may be done for the shaft (at 10 diameters) and for the very tip (at 100 to 850 diameters). For electrodes to be used for intracellular work, the resistance may be measured as the electrode is immersed slowly in saline. Any abrupt changes after contact indicate flaws in the coating which may have failed detection in previous tests.

Fig. 1B shows several coated electrodes that were photographed under water with an optical microscope to show the coating, which is not otherwise visible and which usually extends well beyond where it can be seen by this method, as proved by the bubble tests.

Resistance measurements have been made using a Wheatstone bridge with rectangular pulses or short bursts of sine waves for a signal and a cathode-follower input stage as a detector (4). For small currents (of the order of 10^{-7} amp or less), resistance is fairly independent of direction and magnitude of current, and it varies widely from electrode to electrode, averaging perhaps 75 Mohm but ranging from 25 to 200 Mohm at low frequencies (100 cy/sec). At high frequencies (5 to 10 kcy/sec), the impedance drops to about 0.5 to 5 Mohm even when only the very tip is immersed. Measurements made while recording single-unit action potentials by shunting the electrode to ground with

a variable resistance and calculating resistance from the drop in spike voltage have varied from 2.5 to 10 Mohm.

Direct-current stability of the electrode seems adequate to coarse measurements, as shown by the absence of any obvious instability over periods of 5 minutes, using 100-mv pulses with an inkwriter and direct-coupled amplifier with over-all sensitivity of 40 mv/cm. As might be expected, the electrode must be connected to a high-impedance input if the low frequency response is not to be severely limited, which means that a grid-leak resistor must not be used in the input stage. No evidence for polarization is seen if input current is kept low. It should be noted that excessive grid current may give rise to considerable noise.

Single-unit records from the nervous system have been obtained to date in cats from posterior root fibers, spinal cord, brain stem (reticular substance, dorsal cochlear nucleus, and superior olive), cerebral cortex, and olfactory bulb (Fig. 2). Spikes presumably recorded from outside the cell, averaging 5mv (0.5 to 10 mv), resemble in form those described by Rose and Mountcastle for the indium micropipette (5). Such spikes have also been obtained from cat's cerebral cortex after inserting the electrode through the unincised dura mater. Other spikes, presumably intracellularly recorded, may reach 40 mv with conventional cathode-follower input, and 70 to 80 mv when negative capacitive feedback is adjusted short of ringing. Such spikes have been observed for up to $\frac{1}{2}$ hour with no loss of amplitude.

Finally, in fulfillment of the original

objective, the electrode has been used for recording single units for periods of the order of 1 hour from cerebral cortex in chronic waking cats restrained only by a chest harness (6).

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28 November 1956

Selection of Body Sites for Fat Measurement

With increasing interest in the problem of obesity, workers are turning from such indirect measures as overweight, relative weight, and percentage-of-standard weight to direct measurement of body fat. However, when the superficial fat layers are measured by pinch calipers or by means of roentgenograms (1), the problem arises as to which of many possible sites to employ.

In order to investigate the standardized soft tissue, teleroentgenograms were taken on 100 American-born white males aged 21.0 to 22.9 years (2). With suitable shielding, gonadal radiation was limited to approximately 0.02 r. In all, six regions of the body were x-rayed (forearm, deltoid, thoracic, iliac, trochanteric, and lower leg). From the series of six regions contained on a single 7- by 17-in. film, fat measurements were made at 12 sites. These included the medial and lateral arm, the "pocket" formed by the triceps and deltoid muscles, the lower thoracic site, the iliac crest and spine, the upper and middle trochanteric sites, and the four quadrants of the lower leg (1, 3).

The group studied had a mean stature of 180 cm and a mean weight of 72 kg: it was reasonably representative of young adult American males. All fat thicknesses were positively intercorrelated, with values of r ranging from 0.32 to 0.96. In general, deltoid, thoracic, iliac, and trochanteric fat (areas of "central" fat) showed considerably higher group intercorrelations than "peripheral" or ex-

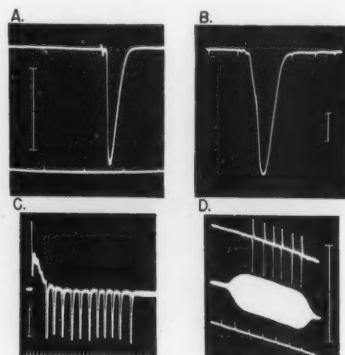


Fig. 2. Single-unit action potentials recorded from cat. (A) S₁: dorsal root, stimulation of same root. (B) Anterior horn cell, spinal cord, S₁. Stimulation of ventral root. (C) "Renshaw cell," spinal cord, S₁. Stimulation of ventral root. (D) Response in dorsal cochlear nucleus to a 4000-cy/sec tone. For all tracings, the amplitude is 5 mv, time is in milliseconds; positive deflections are downward.

tremity fat, as shown in Table 1. Correlations with weight were also higher than those for the central fat sites.

Three fat sites emerged as exhibiting (i) the greatest degree of communality and (ii) the highest correlations with weight. These were the iliac spine (I_2), mid-trochanteric (Tr_2), and lower thoracic (Lt). The predictive rankings for all 12 sites are shown in Fig. 1.

While fat over the pelvis here appears to be the best single predictor of fat in general, as is also true of the older adult male (4), the lower thoracic site may prove to be of considerable practical use.

Table 1. Mean intercorrelations for each fat site, and correlations with weight.

Fat site	Correlations	
	Mean*	Weight
1. Lateral arm (La)	0.65	0.47
2. Medial arm (Ma)	0.55	0.36
3. Deltoid insertion (Di)	0.63	0.51
4. Lower thoracic (Lt)	0.68	0.50
5. Iliac crest (I_1)	0.66	0.50
6. Iliac-spine (I_2)	0.73	0.62
7. Trochanteric (Tr_1)	0.67	0.44
8. Mid-trochanteric (Tr_2)	0.72	0.58
9. Lateral leg (Li)	0.57	0.38
10. Medial leg (Mi)	0.61	0.48
11. Anterior leg (Al)	0.53	0.47
12. Posterior leg (Pl)	0.53	0.35

* Mean of 11 correlations involving each site obtained from the mean Z-transform of r (4).

The fat-plus-skin thickness at the mid-axillary line, at the level of the lowest rib, can be measured on full-size or miniature chest plates, thus extending the value of mass radiography to the assessment of obesity (5).

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24 October 1956

Differential Diagnosis of Hematologic Diseases Aided by Mechanical Correlation of Data

In recent years the increasingly large volume of technical information available in many fields of scientific work has led to difficulties in the efficient classification, correlation, and transmission of data. The position has been taken, by some, that methods which have led to efficient utilization of data in the past may no longer be adequate and should be supplemented by additional techniques (1). This concern has been voiced with regard to medical research and practice as well as to other fields (2). The present study was undertaken to evaluate the efficiency with which mechanical classification and correlation of data might assist in the utilization of data in the differential diagnosis of hematologic diseases.

Clinical and laboratory data characteristic of hematologic diseases were coded for application to marginal punched cards (3). The data included information from the case history, from physical examination, and from peripheral blood, bone marrow, and other laboratory examinations. They were chosen from a standard textbook of hematology (4). The data were classified on the punched cards by assigning them to 138 spaces, a single space representing the same information on all cards. For each of 27 hematologic diseases, a single master card was prepared, and the data characteristic of each disease were inserted on its card by wedge punching in the appropriate spaces. In addition, the most definitive diagnostic criteria of each disease were noted on the corresponding master card.

The records of 80 hematologic cases were then drawn from the files of a well-known university hospital. In each case the diagnosis had been established on widely accepted laboratory and clinical criteria and, in most cases, reflected the judgment of experienced hematologists. Each case was examined separately. With multiple insertions of data, the findings of a hospital case were correlated simultaneously with the data of the 27 diseases. Master cards containing data identical with the hospital case were separated from those not containing such data.

On the basis of the correlation procedure, the cases were grouped in three categories. The largest group consisted of 50 cases. The data of each of these cases were identical with data contained on one master card. The disease represented by the master card in each instance was identical with the diagnosis listed on the hospital record. In addition, it was noted that the code numbers of positive findings in the hospital case were identical with the code numbers of the definitive items needed to establish the diagnosis of the disease.

The second group consisted of 23 cases. The data of each of these cases were identical with data contained on several master cards and were therefore identical with the data of several diseases. By referring to the code numbers listed on each master card for the most definitive diagnostic criteria of the disease, it was possible to note that certain additional items of information from the hospital case were needed to establish the diagnosis of any of the diseases. When these items of information were obtained and entered in the correlation procedure, the data of each of the 23 cases were noted to be identical with the data contained on only one master card. Here, too, the disease represented by the card was, in each instance, the correct diagnosis for the corresponding hospital case.

The third group consisted of seven cases. The data of each of these cases were not identical with the data contained on any card. In each of these cases, more than one hematologic abnormality was present. These cases were examined, an additional procedure being used. A numerical value was assigned to each item of information previously coded in each of the 27 diseases. If the presence of an item of data contributed to the establishment of a diagnosis, the item was given a positive value in that disease. If its presence was not compatible with the diagnosis, it was given a negative value. If its presence would in no way affect the diagnosis, it was given the value of zero. Thus, each item might have a different weight in each disease. A hospital case was studied in

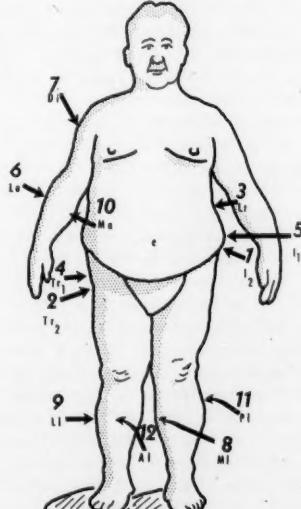


Fig. 1. Predictive efficiency of the 12 fat sites investigated in this study ranked in decreasing order of effectiveness. The lower thoracic site (Lt) can be measured on a routine chest x-ray plate.

terms of each of the 27 diseases. In each instance the weighted average—that is, the ratio of the weight of the hospital data to the sum of weights of all data of the disease—was determined. The actual diseases present scored highest in terms of weighted averages, and the correct diagnoses could be confirmed by referral to the definitive diagnostic criteria. In addition, it was possible to identify diseases which closely resembled the diseases in the hospital case and to note similarities and differences. In one instance the set of diagnoses in the hospital record was incomplete, but mechanical correlation of data by the afore-described procedure resulted in presentation of a complete set of correct hematologic diagnoses.

Study of the methods of correlation of data described in this report revealed that these operations can be performed by electronic computing procedures available at the present time (5). Tabulation of the findings can also be made automatically. It is believed that further evaluation of the efficiency of these methods in correlating data of this type is indicated.

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Radon Solubility in Rat Tissues

An estimation of the tissue radiation dose that arises from the inhalation of air containing radon can be made if, among other factors, the solubility of radon in various tissues is known. In the absence of such information, it has been customary to base estimates of the quantity of radon dissolved in the body on the following assumptions: (i) that radon solubility per gram of aqueous tissue is approximately equal to radon solubility per gram of water or physiological saline at body temperature; (ii) that radon solubility in the fatty tissues is comparable to the solubility of radon in some reference fatty substance such as olive oil.

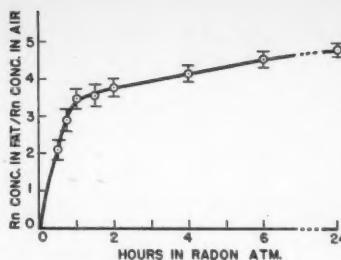


Fig. 1. Radon uptake by fat as a function of time of exposure. The vertical lines represent 95-percent confidence limits.

The values reported for the mean solubility of the entire soft tissue mass in man, based on such assumptions, range from 0.27 to 3.3 times that of the radon concentration in the inspired air (1).

The experiment reported here was undertaken to determine the solubility of radon in selected tissues of the rat and to study the rate at which radon is taken up by the fatty tissues that constitute the body's major reservoir of radon.

Adult Rochester Wistar rats were placed in a 14-lit Lucite inhalation chamber having separate cubicles for six rats. Expired carbon dioxide was absorbed on soda lime, and oxygen was continually supplied to maintain its initial concentration in the chamber air. A 30-minute trial period, to insure that the apparatus functioned properly, preceded the addition of radon to the chamber atmosphere. Except for radioactive decay and losses owing to inhalation, the radon concentration remained constant throughout a given experiment at levels ranging from about 0.5 to 5 μ c/lit of air, as was determined from air samples withdrawn periodically from the chamber.

Exposure periods in the inhalation chamber ranged from 30 minutes to 48 hours, after which the rats were killed by the introduction of 1 lit of carbon monoxide into the chamber. Death occurred within 2 to 3 minutes. Rats were removed from the chamber, and specified tissues were dissected. Tissue samples (0.8 to 1.5 g) were rapidly placed in tared test tubes (50 by 12 mm) (control experiments in which tissue transfer was intentionally delayed indicated that the radon loss in the routine tissue transfer was equal to or less than 5 percent.) Close-fitting glass plungers were inserted into the test tubes until they came in contact with the tissue and were sealed to the test-tube walls with wax.

The relative gamma activity of the air and tissue samples was determined by counting in a well-type sodium iodide scintillation counter after allowing 4 hours for the build-up of radon. Later recounts of the same samples showed no radon loss except that resulting from decay.

The distribution coefficient (radon

concentration per milliliter of tissue/radon concentration per milliliter of air) at equilibrium was found to have the following mean values and standard errors: omental fat, 4.83 ± 0.07 ; venous blood, 0.405 ± 0.016 ; brain, 0.309 ± 0.008 ; liver, 0.306 ± 0.004 ; kidney, 0.285 ± 0.012 ; heart, 0.221 ± 0.013 ; testis, 0.184 ± 0.007 ; muscle, 0.154 ± 0.005 . Experimental results indicate that the maximum, or equilibrium, value of radon concentration is attained much more slowly in fatty tissue than in any other tissue investigated. Tissues other than fat were essentially in equilibrium after 1 hour, and no consistent increase in radon concentration could be detected in any one of the other types of tissue by continuing the exposures for more than 1 hour.

The distribution coefficient shown for omental fat was determined by exposing rats to the radon atmosphere for 24 to 48 hours. The rate of build-up of the radon concentration in the fatty tissue can be observed in Fig. 1, which shows the increase of the distribution coefficient for omental fat with increasing periods of exposure. A half-equilibrium value is attained in about 30 minutes, and after 6 hours the value is at 95 percent of equilibrium. The curve presents data obtained from 90 rats, and the 95-percent confidence intervals are indicated for each value.

The information in Fig. 1 can be further evaluated by plotting it on semi-logarithmic paper as follows: the value of the distribution coefficient at any time t is subtracted from the equilibrium value of the distribution coefficient, and this difference is plotted as a linear function of exposure time. If the curve shown in Fig. 1 represented a single exponential function, then the semilogarithmic plot would yield a straight line. On the contrary, the plot shows a sharp break in the semilogarithmic curve at an exposure period of about 1 hour. Such a plot appears to represent a process having two components with different time constants. The half-time for the fast component is 21 minutes; that for the slow component is 138 minutes. Such bimodality in gas uptake by adipose tissue has been suggested by H. B. Jones (2) on the basis of nonuniformity of blood perfusion within a tissue. Very few studies have been conducted on the uptake and loss of inert gases in single tissues.

By applying to man the values for the solubility of radon in various tissues of the rat, Black (3) has calculated that the mean solubility of the entire soft tissue mass in man is 0.89 as compared with earlier estimates ranging from 0.27 to 3.3 (4).

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11 October 1956

Instrumentation of Fetal Electrocardiography

During the past two decades maternal mortality has been progressively reduced. With the same standard of pediatric care, the reduction in stillbirths and neonatal mortality has been only a small fraction of the gain made in maternal mortality. In addition to the 160,000 infant deaths associated with the birth process each year, there are a large number of infants afflicted with cerebral palsy and mental retardation. It is possible that these problems find a common basis in fetal anoxia.

If significant gains are to be made in this area, a reliable means of accurately determining reversible "fetal distress" must be found. The present "normal" parameters of the fetal heart rate during labor have been charted from periodic auscultatory sampling and are therefore open to some question. If "fetal distress" is to be defined in terms of fetal cardiac rate and rhythm, the limits of "normal" must be defined accurately.

Because only minute amounts of fetal energy are available for study on the anterior abdominal wall of the mother, the basic problem is one of instrumentation. The types of fetal energy which can be detected with present instrumentation are as follows: (i) electric energy—electrocardiogram and electroencephalogram—and (ii) mechanical—phonocardiogram and infrasonic (less than 15 cy/sec).

Since Cremer's (1) success in recording the fetal electrocardiogram in 1906, there have been a number of reports of fetal electrocardiographic studies. By and large, the instrumentation has been limited to some type of preamplifying apparatus used with a standard electrocardiographic machine or an electroencephalograph. In many instances fetal QRS complexes were identified, but there are few records that show consistently recognizable P and T waves.

This preliminary report (2) outlines an instrumental approach to fetal distress using fetal electrocardiography for determination of the normal fetal heart rate throughout the course of labor and the notation of any changes of rate and rhythm which may be related to uterine

contractions or abnormal obstetrical conditions.

In order to record accurately the fetal heart rate throughout labor, some means of removing the maternal electrocardiogram must be employed, since both electrocardiograms are present as vectors in a volume conductor. In principle, this is done by in-phase canceling of the maternal complex in a differential amplifier (Fig. 1). One input channel is connected to electrodes from the lower abdomen of the pregnant patient, where both maternal and fetal electrocardiograms are present. The other input channel is connected to two electrodes on the upper abdomen, where the maternal electrocardiogram alone is present. This maternal complex should be of the same configuration and amplitude as the lower one, for it is used for cancellation. Discrimination against outside electric interference is achieved by using differential amplifiers ahead of the canceling amplifier.

The tracings shown in Fig. 2 demonstrate experimental results that can be duplicated in the majority of patients throughout the course of labor. However, the necessity for matching and balancing one complex against another is a disadvantage, and current exploration of a system for rectification, integration, differentiation, and gating appears to offer a simpler solution.

In order to provide the most accurate definition of the normal fetal heart rate during labor, it is desirable to record it continuously and relate it graphically to the amplitude of the uterine contractions. Experimentally, this is a laborious task. In a 10- to 15-hour labor there are about 100,000 to 150,000 pulse intervals to be measured and plotted against about 150 uterine contractions. Currently it takes about 150 hours of technician's time to process one complete labor. If any reasonable number of labors are to be studied, some type of semiautomatic data-reduction system must be used.

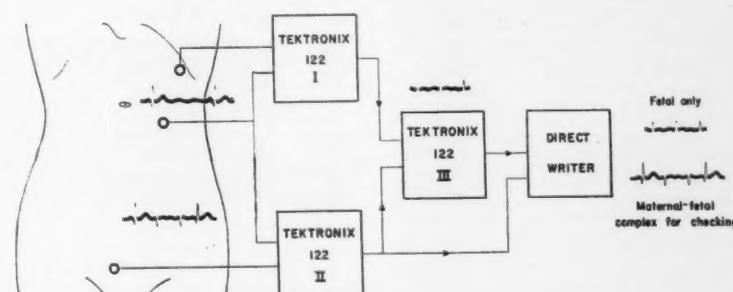


Fig. 1. Apparatus for cancellation of the maternal electrocardiogram. The Tektronix model 122 preamplifiers were connected as shown; the two-channel, direct-writing electrocardiograph is manufactured by the Elema Instrument Co., Stockholm, Sweden.

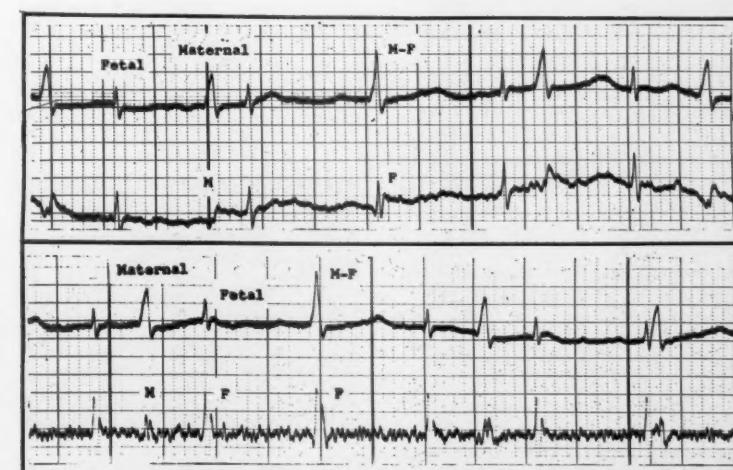


Fig. 2. Cancellation of maternal electrocardiogram: two records obtained with the two-channel electrocardiograph. The upper channels of both tracings show maternal and fetal electrocardiograms. The lower channels show only the fetal electrocardiogram, with cancellation of the maternal electrocardiogram. The lower channel of the bottom tracing shows differentiation for electronic counting.

A system is being developed to reduce the data. The raw data will be recovered from magnetic tapes, and a very compact record will be provided by a two-channel, direct-writing oscillograph if the fetal heart rate falls within predetermined "normal" limits. If these are exceeded, the time base of the writing system will be automatically increased, and a more detailed record will be secured. At the same time, the information will also be digitized and plotted by an $x-y$ recorder.

It is hoped that the use of modern instrumentation methods may aid in the elucidation of clinical fetal distress.

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* Markle scholar in medical science.

12 December 1956

Intraocular Arterial Homotransplants for Studying Atherosclerotic Lesion Regression

The purpose of this report (1) is to introduce the use of intraocular arterial homotransplantation for studying spontaneous or experimentally induced regression of specific atherosclerotic lesions in healthy animals. The operative procedures used were modifications of those employed by several investigators (2). A portion of an artery is excised aseptically and atraumatically from an anesthetized donor animal, rinsed with warm (37°C) mammalian Ringer's solution, and opened longitudinally with sharp scissors. Square pieces of approximately equal size are cut from selected normal or uniformly atherosclerotic areas. One piece is retained as a control for histologic study and for comparison with transplants removed later in the course of the experiments. The others are placed in warm Ringer's solution until they are transplanted into the host animals.

Each of the anesthetized host animals

is taped securely to an animal board to minimize reflex head movements during the operation. Three drops of 0.5-percent tetracaine hydrochloride solution are applied topically to the eye into which a transplant will be made. The sclera is grasped firmly with fixation forceps, and a 3- to 4-mm incision is made through the cornea, near the corneoscleral junction, with a cataract knife. While one edge of the cut cornea is gently lifted with sharp-pointed forceps, a corner of one of the transplants is grasped with slender mouse-toothed forceps and gently inserted through the incision into the anterior eye chamber. A slender blunt instrument (strabismus hook) is used to slide the transplant across the anterior eye chamber to the opposite side and wedge it there between the cornea and iris with the intimal surface facing outward. Finally, a small amount of penicillin ointment is applied to the operated eye. Depending on the experimental plan, transplants of either normal or atherosclerotic arteries may be made into one or both eyes of each host.

Several groups of animals may be prepared. For some experiments, healthy young litter-mate animals of the same sex should comprise an experimental group and serve as hosts for arterial transplants taken from a litter-mate of the same sex. For other experiments, animals of the same or opposite sex from another litter of the same species and strain could be used. In either case, the donor may or may not have been subjected to atherosclerotic procedures.

At selected times (for example, every 3 months), a host animal of each group can be sacrificed, and histologic sections of the normal and atherosclerotic transplants can be prepared by the same methods as those used for the control pieces. The sections of control and transplanted pieces from each group can then be studied to determine the nature and degree of any structural or chemical

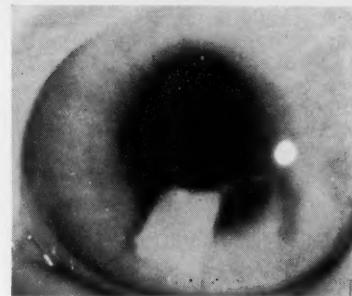


Fig. 2. Homotransplant of normal aorta in the anterior eye chamber of a young female rabbit, 4 weeks postoperatively. No blood vessels invading the intima can be observed.

changes, or both, which may have occurred in the transplants, either spontaneously or as the result of experimental procedures on the host. It may also be possible to determine the order in which each of several changes occurs. Comparison of the results obtained using dogs, rats, or other resistant species with those obtained from rabbits and other susceptible species may reveal some of the reasons for species differences in susceptibility to experimental atherosclerosis.

In experiments with rabbits, recovery of the host animals from the operation is prompt and is not complicated by infection. The adventitia of all the normal and atherosclerotic transplants becomes attached to the anterior surface of the host's iris by fibroconnective tissue in less than 8 days. Within 30 days, the adventitia of all the transplants is invaded by several clearly visible blood vessels from the iris. In addition, the thickened intima of all atherosclerotic transplants becomes extensively vascularized (Fig. 1), but that of the normal transplants does not (Fig. 2).

The transplants of normal aorta have been in place for 6 months, and those of atherosclerotic aorta for $6\frac{1}{2}$ months. It has not been determined how much longer than this they will persist, but apparently there will be sufficient time to permit long-term studies of the effects of drugs, diets, and other experimental regimens on the structure and blood supply of the transplants. These test animals should be more responsive to drugs and diets that may cause regression of atherosclerosis than animals which have been subjected to rigorous atherogenic procedures. Should certain procedures be found to accelerate regression of the transplanted lesions, their application to the treatment of human atherosclerosis is indicated.

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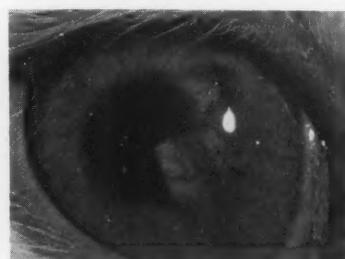


Fig. 1. Homotransplant of atherosclerotic aorta in the anterior eye chamber of a young female rabbit, 4 weeks postoperatively. Note the extensive invasion of the thickened intima by blood vessels from the iris.

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- This article is based on studies supported by U.S. Public Health Service grants H-1020 and H-2302. I wish to express my gratitude to M. H. Knisely, chairman, department of anatomy, for his assistance, advice and encouragement, and to medical students E. R. Cathcart and C. P. Darby for their technical assistance.
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3 January 1957

Excitation Lifetime of Photosynthetic Pigments *in vitro* and *in vivo*

To measure the fluorescence decay of pigments (1) with excitation life-times of the order of 10^{-9} sec, we constructed an electronic instrument that contained no Kerr cells or piezoelectric cells (to avoid unsolved problems of quantitative interpretation of the data). A hydrogen flash lamp (2) supplied a light pulse lasting less than 1 μ sec. The fluorescence induced by this flash was measured with a photomultiplier; the signal was applied directly to the plates of an oscilloscope, and the display was photographed. Figure 1 shows the recordings of the lamp flash (A) and of a fluorescence flash (B). The time constant of the instrument (which accounts for most of the width of the upper curve) is of the same order of magnitude as that of the fluorescence decay; the two effects were separated by mathematical analysis, presuming the decay to be exponential.

The fluorescence lifetime τ of several pigments was determined *in vitro* in this way with a precision of ± 7 percent, and—for the first time—also *in vivo*, with a precision of ± 20 percent. The most important results are given in Table 1.

The quantum yield of fluorescence (φ) can be derived from the measured excitation lifetime τ and the "natural" lifetime τ_0 [calculated by integration of absorption curves; see Lewis and Kasha (3) and Förster (4)] by means of the well-known equations $\tau = \varphi \tau_0$. In the case of pigments *in vitro*, the results can be compared with the quantum yields measured by Förster (5) and by Latimer (6); good agreement was obtained with the results of the latter.

A wide difference appeared, however, between the fluorescence yield ($\varphi = 10$ percent) calculated from the lifetime of chlorophyll fluorescence *in vivo* (assuming τ_0 to be the same as *in vitro*) and that determined by Latimer (2 to 3 percent). One possible interpretation of this discrepancy is to assume two forms of chlorophyll *in vivo* [a hypothesis for which some spectroscopic evidence has been obtained by other investigators (7)]; the fluorescent form must then account for about one fourth of the total, and the nonfluorescent form for about three-fourths of the total. An alternative is to attribute the discrepancy to different conditions of the experiment—more specifically, to associate the higher value (10 percent) with the "dark-adapted," and the lower value (2 to 3 percent) with the "light-adapted" state of the cells.

With red algae, we were able to observe a difference in the rise of phycerythrin-sensitized, as compared with that of direct chlorophyll fluorescence (Fig. 2). The former was delayed by

Table 1. Fluorescence lifetime of pigments. The accuracy of the measured lifetimes varies from ± 0.4 to $\pm 0.5 \mu$ sec.

Material	τ (μ sec)	τ_0 (μ sec)	$\varphi = \tau/\tau_0$
Chlorophyll <i>a</i>	7.8	15.2*	0.33†
in benzene	5.1		
in ethyl ether	6.9		
Chlorophyll <i>b</i>	6.3	23.0*	0.17†
in benzene	3.9		
in methanol	5.9		
Chlorophyll <i>a</i> <i>in Chlorella</i>	1.6	15.2*	0.11†
in <i>Porphyridium</i>	1.5		
in <i>Anacystis</i>	1.2		
Methyl chlorophyllide (<i>a</i> + <i>b</i>)	6.7	8.3‡	0.85§
in benzene	4.8		
in methanol	6.5		
Phycerythrin in phosphate buffer (pH 6.0-6.2)	7.1	3.0‡	0.53§
Phycocyanin in phosphate buffer (pH 6.0-6.2)	1.8		
Fluorescein	4.8	5.3‡	0.91§
Eosin Y	1.6		

* Natural lifetime was determined by integrating the absorption band of chlorophyll in ethyl ether.

† Fluorescence yields were calculated from lifetimes; they agree well with the direct determinations of Latimer (6) in solution and are about 4 times higher *in vivo*.

‡ Fluorescence yields were determined by Latimer (6).

§ Natural lifetime was determined from measured lifetime and fluorescence yield.

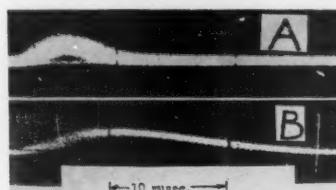


Fig. 1. Typical cathode-ray tube displays. Curve A, response of the instrument to the lamp flash; curve B, fluorescence of chlorophyll *a* in methanol.

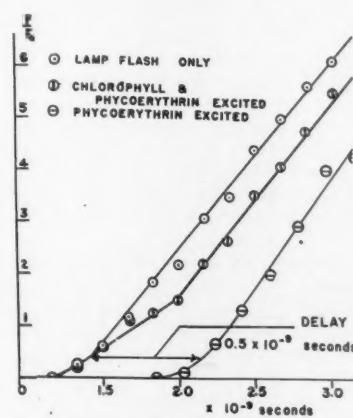


Fig. 2. Onset of direct and sensitized fluorescence.

about 0.5 μ sec—in approximate agreement with the value one can calculate from the life-time of phycobilin excitation *in vitro* and the efficiency of energy transfer from the phycobilins to chlorophyll *in vivo* as estimated by Duygens (8).

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17 December 1956

Book Reviews

Let ERMA Do It. The full story of automation. David O. Woodbury. Harcourt, Brace, New York, 1956. xiv + 305 pp. Illus. \$5.

David Woodbury's 12th book about some of the mysteries and achievements of science and technology, written for the nontechnical layman, is one of his best. The first half of the book, "This business about automation," is an absorbing discussion of the development of automatic devices and techniques in relation to the concomitant social and economic changes. By citing experience, Woodbury advances the thesis that automatic manufacturing and accounting or computing processes have not displaced human workers—they have freed them for more skilled occupations and better pay. They have increased the general level of employment by requiring more persons to plan and make decisions instead of performing the same routine operations day after day. The analysis of certain major business functions or manufacturing processes facilitates an understanding of what can be done, more and more, by mechanics and electronics, and what man still must do. Why have the motor-car industry and petroleum refineries been so receptive to, and successful in, automation? Why cannot the manufacture of beer and of pretzels be made automatic in a similar manner?

The second part of the book, "ERMA and her friends," is a description of several of the outstanding electronic devices in current use, or now being developed. One of the earliest, ERMA (Electronic Recording Machine—Accounting), has revolutionized the keeping of depositors' accounts and the issuance of monthly statements in banks. ERMA's other friends, such as UNIVAC, ENIAC, MANIAC, SAGE, RAM, and MAGGIE, are introduced so clearly that anyone who adds or subtracts can understand what they are intended to do. Perhaps MAGGIE or one of her future offspring may some day keep the AAAS membership and journal subscription records. So far, the extraordinary electronic devices are not substitutes for human brains, yet they do decide between predetermined alternatives. The future, however, will

witness great improvements in the capacity and versatility of these machines. The concluding chapter, "Where do you and I fit in?" leaves the reader with the task of finishing the story insofar as his own future activity may be related to the rapidly expanding world of automation.

HILARY J. DEASON

Washington, D.C.

Documentation in Action. Jesse H. Shera, Allen Kent, and James W. Perry. Based on the 1956 Conference on Documentation at Western Reserve University. Reinhold, New York; Chapman and Hall, London, 1956. 471 pp. Illus. \$10.

At the beginning of 1955, the School of Library Science of Western Reserve University brought together a group of some 19 people from various organizations and institutions to help plan a conference which would concern itself with the following aspects of documentation: (i) use of recorded information; (ii) improvement of the availability and utility of such information; (iii) development and application of new methods, systems, and equipment; and (iv) training of personnel. Together they planned a symposium which was called the Conference on the Practical Utilization of Recorded Knowledge. It was held in January 1956. *Documentation in Action* is, in effect, the proceedings of the conference.

In reviewing a work of this type, one cannot help comparing it with the proceedings of the Royal Society Scientific Information Conference, which was held in London a little over 7 years before the Western Reserve University conference. In many respects, the programs and purposes of the two conferences are similar.

One is also tempted to compare the Western Reserve conference with the projected International Conference on Scientific Information, now being organized by the National Academy of Sciences in collaboration with the American Documentation Institute. Here, again, the program and organizational structure

are quite like those of the Western Reserve conference. In all three conferences, the basic scheme appears to be much the same. All involve working committees and working papers which deal with different aspects of librarianship and documentation.

The thing that most clearly distinguishes the Western Reserve conference from the other two conferences is the nature and derivation of its working papers. In both the Royal Society conference and the projected international conference, a basic criterion of the papers is originality. The working committees in the Royal Society conference were asked, and those of the international conference are being asked, to enlist the aid of specialists in the conduct of firsthand investigations in the problem areas defined by their planning committees. This method is calculated to bring forth original papers based on original research.

In the case of the Western Reserve conference, the accent is on essay-type papers in which groups of experts, from their own knowledge and experience, sum up the problems and developments of the day and the possible significance of these problems and developments. In some instances, the resulting working papers lean very heavily on the past literature in the field of documentation and librarianship for their substance. In other instances, we have "thought" pieces, which reflect the professional feelings and opinions of the writers.

In any attempt to summarize and synthesize contemporary ideas in a field, one must tread the very fine line that divides the informative distillation from the stereotyped rehash. *Documentation in Action* falls on both sides of the line.

The first part of the book consists of seven chapters which review "present requirements, methods and problems" in documentation. It begins with a well-developed glossary of documentation terminology. This is followed by a discussion of interorganizational endeavors in the dissemination of information. This subject was apparently uppermost in the minds of the organizers of the Western Reserve conference. Twelve of the 26 chapters in the book touch on it in one way or another.

The third chapter is a sort of exercise or demonstration in the use of operations-research in formulating decisions. It does not seem to fit in with the other six chapters in the first part of the book. The fourth chapter gets back on the track with a discussion of the present status of education in librarianship. The fifth chapter leaves the track again with a rather overladen discussion of the characteristics of recorded information.

The sixth chapter is given to an exhaustive and informative inventory of

methods and devices for the analysis, storage, and retrieval of information. This chapter comes closest to what one would imagine to have been the goal of the conference. It summarizes the present status of the various conventional and *avant-garde* systems for organizing bodies of scholarly and technical information in ways that will make them most useful. It does this in a way to interest the reader in possibly looking into the available systems and maybe even making some use of them.

Like the sixth chapter, the seventh brings us more or less up to date in an important and basic area of documentation: studies of the mechanisms by which people who need information go about getting it and using it. This chapter would have been better if the authors had resisted the temptation to inject value judgments. Nevertheless, it serves as a challenge by focusing attention on the fact that the documentalist and librarian really know very little about the people for whom they are trying to make information readily available.

With the exception of four later chapters, nothing in particular would have been lost, and probably a good deal would have been gained, if *Documentation in Action* had ended with chapter seven.

The first of the four exceptions is a chapter entitled, "Men, information, and now automation in the decision-making process." It is a clearly speculative look at the future role of computers and computerlike machines in operations-research and in library reference work. It helps to underline the economic and other practical advantages of using such machines and the role of interorganization cooperation as an economic expedient in their use.

The second of these notable chapters is entitled, "Information theory and the retrieval of information." It attempts, with considerable success, to set forth the problems and possibilities of applying information theory to bibliographic organization. We are given a look at some of the problems which may be involved in the utilization of digital computers for storing and searching information and for preparing bibliographies.

The next chapter is in the same vein, with the important addition that it gives some indication of the inner workings of these machines. In so doing, it helps the librarian and documentalist to formulate his requirements and aspirations for mechanized searching in terms which take into account the things that machines can and cannot do and the limited means by which they do the things they do. One of the factors that has slowed progress in the development of mechanized searching devices is the fact that li-

brarians and documentalists have not known how to speak to the machine-designers, and vice versa.

The last of these four chapters is one which deals with the bibliographic problems of law. It is rather unfortunate that most of the activities in documentation, to date, have concerned themselves only with natural science and technology. The law represents an area of activity which is uniquely dependent on the literature for its substance. It has a rich and mature literature whose organization for practical use has given rise to many important and basic innovations in publishing, librarianship, and documentation. The organizers of the Western Reserve conference showed foresight in including problems of legal bibliography in their deliberations.

In organizing the conference on which this volume is based, the members of the Western Reserve University School of Library Science managed to bring together some of the best available minds in the field of documentation and librarianship. It seems a pity that better use was not made of this unusual array of talent. *Documentation in Action* belabors certain subjects—cooperative information processing, for example—but leaves many important questions unanswered. Perhaps this reflects the present state of documentation and librarianship.

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Portraits from Memory. Recollections of a zoologist. Richard B. Goldschmidt. University of Washington Press, Seattle, 1956. 181 pp. + plates. \$3.50.

When I finished reading *Portraits from Memory* I decided that a note of appreciation to the author was in order. After I was asked to review the volume it became evident that a review could take no more fitting form than a public note of appreciation. I should like to take this opportunity to thank Richard Goldschmidt for perpetuating his precious memories. The portraits which he has sketched with such skill and deftness will be invaluable to generations of biologists. Many of the German founders of zoology are made to live again as human personalities within a framework of their scientific achievements and efforts. Few biologists remain who are familiar with the inception of so many fields of biology. Only Goldschmidt could link these beginnings with the personalities who were intimately associated with them.

Two other things are made clear in this small volume. Goldschmidt's description of German university life of

the early 1900's, with its emphasis on research and devotion to high standards, re-creates the atmosphere in which so many important developments took place. Over and above this, the book serves as a self-portrait of the author. In the descriptions of his many friends and teachers we cannot fail to observe the awareness, the sensitivity, and the many vital interests of Goldschmidt himself. At times he is sharp and critical, with little patience for the self-satisfied and dull. Yet, throughout, one notes a feeling of affection—and nostalgia—for his former acquaintances.

This book is recommended reading for all graduate students of biology who are interested in the background of their science—and for their teachers too.

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National Science Foundation

Rheology, Theory and Applications. vol.

1. Frederick R. Eirich, Ed. Academic Press, New York, 1956. 761 pp. Illus. \$20.

In this book, 23 authors have written 17 chapters dealing with the fundamentals of rheology. It is to be followed by two companion volumes, continuing the fundamental considerations and extending over into the applied fields.

If a condensed phase be thought of as a giant molecule, then any change in the relative position of the component molecules is an isomerization, and the relaxation processes involved can be treated like any other chemical reaction. It follows that shear stresses, like other types, simply act to lower the free energy of the activated, and of subsequent, states with respect to the initial state of the system. From this point of view, non-Newtonian viscosity is the general case, Newtonian viscosity being the limiting process approached at low rates of shears. Bondi develops this relaxation-theory approach at some length. Other chapters consider other aspects of relaxation theory.

Another approach to viscosity is to calculate the molecular distributions of the molecules in liquids in the resting state and then calculate the forces associated with the distorted distributions accompanying flow. This method is accurate, in principle, and leads to some interesting results. However, to make the calculations manageable, one usually has to introduce various approximations. Riseman and Kirkwood, in a chapter entitled "The statistical mechanical theory of irreversible processes in solutions of macromolecules," have discussed this procedure.

In other chapters, Reiner discusses

macrorheology; Prager treats finite plastic deformation; Drucker considers the stress strain of metals; Dienes develops the role of imperfections in plastic flow; J. M. Burgers and W. G. Burgers develop dislocation theory. There are other excellent chapters, but this gives an idea of the interesting subjects discussed in a book which all rheologists should read.

Although the various authors stress their special interests and so give a rather uneven treatment of the field of rheology, this comprehensive book is a valuable addition to the rapidly growing rheological literature.

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New Books

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Meetings and Societies

Size and Shape of the Earth

Quite frequently I have been asked, "You used to be a geodesist—what are you doing in fact?" When I have answered that the most important practical purpose of a geodesist is to carry out all the measurements and computations needed to establish a reliable control-point system, without which no adequate mapping would be possible, I have been answered, "Now I know—you are a 'tape man.'"

About a century ago it was still nearly correct to say that the men who were making or leading the measurements for the mapping work were "tape men," because then the classic method of measurement by rods and tapes was generally used. However, now it is as far from the truth as east is from west to claim that geodesists who are working with the size and shape of the earth are tape men; geodesists—for instance, the American, Hayford, who derived the constants of the international earth ellipsoid, the Dutchman, Vening Meinesz, who has made gravity observations from submarine at sea, and Walter D. Lambert, the grand old man of American geodesy—hardly have seen surveyors' tape. I used it for the last time two decades ago.

Now the geodesists need quite different methods, because problems are different. Even in local surveying, tape has been replaced by optical measuring equipments. In triangulation we do not need the usual tapes at all but, instead, Invar wires and a light-interference comparator to measure the base lines. The old methods for measuring details have been replaced essentially by aerial photogrammetry. As far as geodesy in general is concerned, the tape can be put in the museum.

To start with, we must know the size and shape of the earth. Both have been determined by the aid of arc measurements. In arc measurement, we measure, along the earth's surface, arcs that are as long as possible, and make astronomical observations of latitude, longitude, and azimuth at the end-points of the arcs. These observations yield the central angle corresponding to the measured arc. The arc itself is measured by triangulation. This means that we measure only the

angles of consecutive triangles and only a few base lines to get a scale for the triangulation. The longest of the measured arcs is the arc from the Arctic Ocean to Cape Town in South Africa along the meridian 24° east. This method has given dimensions of the earth ellipsoid that are sufficiently accurate for most practical purposes.

During this century we have faced new problems, and therefore new methods have had to be discovered. Earlier all countries had their own geodetic control-point systems. In general, these systems, even those of neighboring countries, were quite different. Nobody knew how big the differences were. For the purposes of one country, even poor dimensions of the earth and classic triangulation were sufficient. Now we have to convert not only the geodetic systems of different countries but also those of different continents into a world geodetic system. In addition, it is becoming more and more desirable to be able to compute superlong distances, even across the oceans. In order to do all this, we have to know very accurately the dimensions of the earth. If, for instance, our measurement of the radius of the equator has an error of only 200 meters, then the computed distance from Washington, D.C., to Melbourne, Australia, would have an error of about 500 meters. In addition, we need the detailed shape of the sea level and its continuation under the continents. We call this surface the geoid. In other words, we must know both the earth ellipsoid along which we make the computation of the control points of different parts of the world and the deviations of the geoid from the ellipsoid and its inclination as referred to the ellipsoid. The deviations of the geoid, or undulations as we call them, and the inclination of the geoid cannot be obtained from a general formula but must be computed from point to point.

When all this has been done, we can convert the existing geodetic systems into the same world geodetic system. It is immaterial where the initial point of the world system is—in Washington, in Paris, in London, or somewhere else. What is most important is that the control points of every continent are computed in the same system.

Now we have, in addition to the classic arc-measuring method, at least four celestial methods, which use the moon or an artificial satellite as one triangulation point, and also the very flexible and very important gravimetric method.

To compare these different methods and to discuss in what way they can be combined to get the most benefit for geodesy and to get the main problems of geodesy solved as soon as possible, preparations were begun a year ago, at the initiation of the late Father Macelwane, professor of geophysics in St. Louis University, for holding a large-scale symposium, "Size and shape of the earth," at St. Louis University in November 1956. I had the honor to be the chairman of the steering committee for this symposium. Since it was impossible to get sufficient support for such an international symposium, the meeting was canceled. However, because interest in this subject is at the present time very keen all over the world, and because a great deal of preparatory work had already been done by the steering committee of 12 scientists, I thought that it might be good to try to arrange a "substitute" symposium.

When the National Science Foundation (U.S.) and the Graduate School of Ohio State University generously promised their support, we were able to carry out these plans. The symposium, which met 13–15 Nov. 1956, was sponsored by the Institute of Geodesy, Photogrammetry and Cartography and by the Mapping and Charting Research Laboratory of Ohio State University. The supporter of the World-Wide Gravity Project at Ohio State University, the U.S. Air Force Cambridge Research Center, also gave its wholehearted support.

The symposium had four sessions dealing with the "Classic and modern arc-measuring method," "Celestial methods," the "World gravimetric system," and the "World geodetic system."

In the arc-measuring method, we need the measurements of angles and base lines as well as astronomical observations of latitude, longitude, and azimuth. Since not very much essentially new has been discovered in astronomical observation during this century, this aspect was left out of the program. Instead, there were several addresses concerning triangulation, the measurement of standard base lines, and electronic methods, particularly shoran. Albert J. Hoskinson (retired chief, Geodesy Division, U.S. Coast and Geodetic Survey) gave a paper on the geodetic works of the Coast and Geodetic Survey and the accuracy required. As we know, the Inter-American Geodetic Survey takes care of the geodetic measurements of different types in Latin America in close cooperation with scientists of different countries. Concerning these measurements James Case (Institute of

Geodesy, Photogrammetry and Cartography, Ohio State University) gave a picture story about the measurements there. He had been conducting for 3 years measurements of some groups.

T. J. Kukkamäki (Finnish Geodetic Institute) sent a paper, "Standard base lines unify triangulations and trilaterations." In this paper, he explained the light-interference method devised by the Finnish professor, Y. Väisälä and used by the Finnish Geodetic Institute. Standard base lines which are yielding an accuracy of 1/10,000,000 (1 inch per 160 miles) have been measured so far in Finland and in Argentina and will be measured next summer in the Netherlands and in Germany. It is hoped that one such type of standard base line will be measured in the United States, perhaps in Columbus. Since modern triangulations give an accuracy of 1/1,000,000, as the triangulations of the Baltic Geodetic Commission show, it is highly desirable that the Invar wires that are used in the measurements of field base lines be calibrated in very accurate standard base lines.

The electronic methods developed during the last two decades have opened a new phase in geodetic measurements. Best known of these methods is shoran, which has been designed, developed, and applied in the United States and Canada on a large scale. The principle of this method is as follows. We measure the propagation time of the electromagnetic impulses or light waves from the observation points to the target and back. The impulses are sent from an airborne station and are reflected from the ground stations *A* and *B*. By the aid of this method, we can measure directly the distance *AB* up to 900 kilometers. The accuracy of these methods is dependent, of course, on how well the effect of many disturbing elements of the atmosphere can be eliminated or measured. An accuracy of 1/100,000 has already been obtained.

J. E. R. Ross (Dominion geodesist, Ottawa, Ontario) gave a very interesting paper, "Accomplishment of geodetic shoran survey in Canada." The new method has made it possible to measure the vast wilderness areas of the northern part of Canada, where other methods would take too much time. In general, Canada begins to be one of the geodetically best surveyed countries.

W. P. Scales (Fort Belvoir, Va.) told about continuous wave-distance measuring equipment. C. E. Westerman (Fort Belvoir) discussed the latest developments in geodimeters. Three different types of geodimeters, originally devised by the Swedish geodesist Bergstrand, were checked by the scientists at Fort Belvoir. These checks revealed that rather high accuracy, 1/1,000,000, can be obtained

with good conditions. It will be seen on how big a scale this method will replace the use of the usual field base lines. Whatever method we might use in triangulation, either the classic or the electronic method, the equipment must be calibrated, and calibration can be accomplished only from standard base lines.

Armando Manzini (Aeronautical Chart and Information Center, St. Louis, Mo.) gave the last paper of the first session, "Computation of distances and azimuths of superlong geodesic lines." Until recent times, it has been necessary to compute only distances up to some 100 kilometers; now, when we join the continents to the same system, we must compute distances even to 10,000 kilometers. For this purpose, quite a few more or less new methods have been developed. Manzini gave a short analysis of the speed of these methods and the accuracy obtained.

Most fascinating, without a doubt, are the celestial methods: the solar eclipse method, star occultation, moon camera, and the artificial satellite method. In the solar eclipse method, developed by I. Bonsdorff, late director of the Finnish Geodetic Institute, B. Lindblad, director of the Stockholm Observatory, Gaviola in Argentina, and Francis Heyden, director of the Georgetown College Observatory, Washington, D.C., the moon is used as one triangulation point. We measure the exact moment when the totality of the eclipse begins and ends at three stations *A*, *B*, and *C*, of which *A* and *B* are on the same continent and *C* is on another continent. When we know, by aid of triangulation, the distance *AB*, we can compute the accurate distance of the moon and use this distance for computing an accurate distance *BC* across the ocean. This method was used in 1945, 1947, and 1954 to measure the distances between South America and Africa and North America and Europe. Heyden's expeditions have, in addition, used several solar eclipses to measure distances between Africa and the Far East. Altogether, at least 40 expeditions have been sent so far to observe total solar eclipses for geodetic purposes. The results have not been promising. Most of the time it has been cloudy or raining at the time of the eclipses, so that no observations have been possible. Accuracy is not as high as we anticipated beforehand. The moon's irregular limb is one of the main sources of error. Only one paper, a publication by Kukkamäki, gives the distance across the ocean—namely, the distance between the observing sites of the two Finnish expeditions, one in Brazil and one in the Gold Coast. The accuracy, however, is only about 120 meters.

Heyden has continued using a less accurate, but also more convenient, method, the light-intensity method, during several solar eclipses. He gave a paper, "Com-

ments on the solar eclipse observations by photographic and photoelectric methods," in which he evaluated different methods. Unfortunately, he did not discuss the obtainable accuracy.

R. A. Hirvonen (Finland Institute of Technology) was, in 1947, the leader of a Finnish expedition to Brazil and, in 1954, the leader of an expedition to Oland, Sweden. His paper was, "Accuracy of the photographic method." Discouraged by the bad luck of most of the solar eclipse expeditions, he was quite pessimistic about the possibilities of this method.

David K. Scott (U.S. Naval Observatory) told about "Measuring of the profile of the moon's visible limb." Scott has participated in the studies of Watts in which attempts have been made for a decade to measure the profile of the moon's limb. This big work will be of basic significance to whatever purposes the observations of the moon's limb may be used.

The Mapping and Charting Research Laboratory of Ohio State University had the pleasure to establish, under the auspices of the Air Force Cambridge Research Center, four expeditions to observe the total solar eclipse in 1954, which was seen in America, Europe, and Asia. (The next equally good opportunity will come 197 years later). These expeditions used only the accurate Bonsdorff and Lindblad methods. The leaders of the expeditions were Frederick J. Doyle (Institute of Geodesy, Photogrammetry and Cartography, Ohio State University) at Knob Lake, in Quebec; A. E. Halbach (Astronomical Observatory of Milwaukee) at Okak Island, in Labrador; T. J. Kukkamäki in Greenland; and J. Allen Hynek in Iran. Unfortunately, none of these expeditions had success because of "heavenly sabotage." Doyle told a picture story about the experiences of the Knob Lake expedition.

Arne Slettebak (Perkins Observatory) told of the possibility of the occultation method. He has made theoretical studies of this method, which is quite similar to the solar eclipse method. The only difference is that, in the occultation method, the moments when a star disappears behind the moon's limb and again emerges from behind the limb are observed. Rather little has been published about the achievements of this method.

Very important and practical seems to be the moon camera method devised by W. Markowitz (U.S. Naval Observatory). The moon camera permits photographing of the moon and the neighboring stars so that the stars and the moon's limb will be stationary during the exposure, and consequently the images will be distinct. By measuring the small angular distances of the different points of the moon limb from the neighboring

stars, the direction to the moon can be computed. In his paper, Markowitz told about the Moon Position Program and how the general shape of the geoid can be obtained by this method. During the International Geophysical Year, about 20 observatories around the world will participate in the Moon Position Program.

J. Allen Hynek (Satellite Tracking Commission and Harvard University) told about the "Accuracy of the satellite tracking position." In addition, he gave a popular lecture, "Artificial satellites," at the dinner meeting on 14 Nov. If the artificial satellite can be observed sufficiently accurately, then this method will give new possibilities for measuring the size and general form of the earth. Of course, it is too early to say anything concerning the accuracy, because the satellite is not yet in the sky. It is the hope of the scientists working with this program that important results can be obtained.

Paul Herget (Cincinnati Astronomical Observatory), told about "Computations for Vanguard satellites."

The third session brought us to the gravimetric method. The prerequisite of all geodetic methods is having as good observations as possible, because geodesy is, perhaps more than any other science, struggling against observation errors, of different types. To get good results, we must have excellent measuring instruments, and these we have at least in gravimetry.

The new gravimeters are like a miracle if we compare their achievements with the results obtained by the old pendulum method. The gravimeters—spring balance principle—permits the measurement of gravity in 3 to 5 minutes with 20 to 50 times higher accuracy than pendulum apparatuses are able to accomplish in 2 days. The pendulum equipment weighs 2000 pounds; the modern Worden gravimeter weighs only 10 pounds.

We had the pleasure of having in the symposium the two best known inventors in this field, Lucien LaCoste (LaCoste and Romberg, Austin, Tex.), who has invented different types of gravimeters, one even for gravity observations from the submarine and one for the measurement of the earth tide, and Sam Worden (Houston Technical Laboratories), inventor of the geodetic Worden gravimeter, which in my opinion is the best of this type—it can measure big gravity differences accurately without any readjustment. This gravimeter has been used in most of the world-wide gravity measuring trips.

LaCoste gave a paper, "Gravimeters for accurate measurement of earth tides." The accuracy he gave was, in fact, very high. Earlier we used the milligal as a unit ($1 \text{ mgal} = 0.001 \text{ cm/sec}^2$); he used the microgal ($1 \mu\text{gal} = 0.001 \text{ mgal}$). His

tables showed that an accuracy of about 2 microgals can be obtained; this means that we can measure the periodic variations of gravity with a relative accuracy of $1/500,000,000$. This type of instrument will be used, particularly during the International Geophysical Year, simultaneously in different parts of the world.

Worden brought his "toy cabinet," an enormously instructive and important collection of models of different gravimeters. This collection gave good ideas of the principles of gravimeters. One picture tells more than 1000 words; one model tells as much as 100 pictures.

To be able to use the anomalies of gravity for geodetic purposes, we must have gravity observations from different parts of the world. The oceans, which cover about 70 percent of the earth's surface, have been in this respect the "Achilles heel." Fortunately, F. A. Vening Meinesz (the Netherlands) invented in 1923 a special pendulum apparatus to be used for gravity observations at sea from submarines. He himself measured gravity at about 850 points in different oceans. These observations have been continued by the Columbia University group under the leadership of Maurice Ewing and Lamar Worzel. These observations include more than 3500 points. Worzel gave a paper, "Gravity measurements at sea," in which he told about the latest observations. Without the efforts of Vening Meinesz and Worzel, the geodetic applications of the anomalies of gravity would hardly be possible!

Seven percent of the ocean area is shallow shelf area with depths less than 200 meters. The submarine cannot be used in shallow waters. Therefore, it is very significant that the Gulf Oil Company invented about two decades ago a special underwater gravimeter which is sunk to the bottom of the sea; readings are made from the surface boat. Later on, about 30 underwater gravimeters were made by different inventors and companies. The Gulf Oil Company generously loaned its underwater gravimeter to the Finnish Geodetic Institute to be used for the gravity survey of the waters of the Baltic Sea. T. B. Honkasalo (Finnish Geodetic Institute) made this gravity survey at 170 points last summer. His paper concerning these observations was referred to in the symposium.

G. D. Garland (University of Alberta, Canada) gave an interesting summary about the enormous number of gravity observations that have been carried out in Canada.

All gravity observations of the world must be made in the same system. Fortunately, during the last decade there has been particular interest in different countries in connecting the national base stations to the same system, the Potsdam

system. Some scientists of France, Great Britain, and Italy have done a good job in this respect; however, G. P. Woollard's group at the University of Wisconsin has alone done more in this respect than all the others combined. Using the Worden gravimeter, Woollard and his students have flown several times around the world in different directions and have occupied more than 3000 gravity base stations on the continents and on most ocean islands too. As a result of this global work, the world gravity data are now in the same system, approximately with the accuracy of 1 milligal. Woollard's paper concerning the last world-wide observations was delivered at the meeting.

We understand well that no one country alone can accomplish the necessary geoid studies on a world-wide scale. We need international cooperation. The central international organization is the International Association of Geodesy, which has its offices in Paris. This organization sponsored an International Gravimetric Conference in Paris last September. In this conference about 20 nations were represented. Donald A. Rice (chief of the Department of Gravity and Astronomy of the U.S. Coast and Geodetic Survey), who was the main representative of the United States (others were Walter D. Lambert and I) told about this conference.

The main purpose of this conference was to arrange the gravimetric calibration lines to all continents. Essentially they have already been measured in Europe and North America, but other continents still do not have such measurements. The purpose of these calibration lines is to permit the calibration of the gravimeters to be used. In addition, there was in Paris a discussion about cooperation between the West and East. The center of the Potsdam system is in the Eastern Zone of Germany. Since World War II no Western scientist has been able to make gravity observations in Potsdam. As a result of private discussions during the meeting, T. B. Honkasalo was allowed to go to Potsdam to join gravimetrically the base stations at Helsinki, Copenhagen, and Potsdam. It is to be hoped that other scientists can also make similar measurements later on.

The amount of gravity material that has been collected is already so enormous that one must have some gravimetric "clearinghouses" to analyze the material and to bring the data in to the same world system. Quite a bit of such work has been done in some geodetic institutions, such as the Coast and Geodetic Survey of the United States, the Geodetic Commission in the Netherlands, and the Geodetic Survey of India. It was also realized that we need additional analyzing centers. In 1936 the International Union of Geodesy and Geophysics estab-

lished the International Isostatic Institute in Helsinki, Finland, under my direction. The main purpose of the institute has been to prepare isostatic reduction maps and tables and to make isostatic reductions at the individual gravity stations. This work has been done for a large part of the Eastern Hemisphere and for large areas of the oceans. The work will continue in close cooperation with the Columbus center. In 1948, there was established in Paris the International Gravity Center under the direction of Pierre Lejay. The main purpose of this center has been to make gravity observations in France and French territories. The center has also been interested in establishing calibration lines and tying the base stations into the same system.

In 1950 I had the privilege and opportunity to establish, and later on to conduct, the World-Wide Gravity Project of the Mapping and Charting Research Laboratory of Ohio State University. This project was sponsored by the Cambridge Air Force Research Center. The purpose of the project is to apply the gravity anomalies to all possible geodetic purposes. This work has been made possible only by close cooperation with other groups in various countries. At present, the geodetic institutions and private geodesists of 35 countries and several oil companies are in close cooperation with the Columbus center. They will even send in unpublished gravity anomaly maps and gravity data. I gave a short paper concerning the gravimetric part of international geodetic cooperation.

Walter D. Lambert (retired chief of the department of gravity and astronomy, U.S. Coast and Geodetic Survey) lifted our eyes from the earth to the higher sphere. He gave a paper on "Normal gravity field in high elevations," a problem which he, as consultant of the Columbus gravity project, has studied for quite a long time. It was revealed that, if we know the gravity anomaly field on the earth's surface, we can compute the gravity field at any elevation. This will be very important later on when the computations of the artificial satellite observations will be actual.

The last session dealt with the world geodetic system. Since the representative of the Army Map Service was unable to attend the symposium, I gave a short report, "Dimensions of the earth according to the Army Map Service." This report called attention to the enormously important studies made by the Army Map Service concerning the dimensions of the earth under the leadership of Floyd W. Hough. These studies, published recently in the *Transactions of the American Geophysical Union*, showed that the Army Map Service now has much longer measured arcs available than ever before. Consequently, the results are obviously

of higher accuracy than the earlier ones. This study indicated also that it is very important to combine the arc-measuring method with the gravimetric method. The classic method cannot give at any point the absolute undulations of the geoid or the absolute deflections of the vertical, so, depending on what value for these quantities will be given at the initial point of the different arcs, we will get different values for the dimensions of the earth. In addition, it was clear that the observed deflections of the vertical cannot be used to compute the dimensions of the earth. The deflections must be isostatically reduced. The equatorial radius a obtained by the Army Map Service is 6,378,260 meters, or 128 meters less than the radius value of the international ellipsoid. It remains to be seen how much this value will change when the gravimetric method is also applied.

Fortunately, the earth topography is in broad lines in isostatic equilibrium. This means that the mountains are supported by the root formations in a way similar to the way icebergs are supported by sea water. The roots of a mountain are about 4 to 5 times as high as the elevation. So the earth's crust under the mountains is thicker than it is under the level lands. Similarly, the earth's crust is thinner under the oceans. The root formations of the mountains and the anti-roots of the dense material of the oceans compensate the mass plus of the mountains and mass deficiency of the oceans, so that the undulations of the geoid are only of the order of 100 meters. If isostatic equilibrium did not prevail, the undulations of the geoid would be of the order of 1 mile. In that case, the material existing now would not be sufficient to compute the shape of the geoid. Lassi Kivioja (Mapping and Charting Research Laboratory) gave a paper, "Significance of the isostatic equilibrium," and explained the problems involved.

Urho Uotila (Mapping and Charting Research Laboratory) gave a paper, "Determination of the shape of the geoid," which, in fact, was a summary of work done in Columbus under the World-Wide Gravity Project. There were shown the different kinds of computations one has to carry out to get the reliable gravity anomaly maps that are needed to compute the undulations of the geoid and the deflections of the vertical. These studies showed also that the International Gravity Formula that has been used, practically speaking, in all gravimetric studies, needs only very small corrections, if any. It was also made clear that we cannot extrapolate the gravity anomalies very far from the computation point. The studies, particularly those made by R. A. Hirvonen, made it clear that this can be done only in the neighborhood of the station to the distance of

300 kilometers. Beyond this boundary, it is best to use the isostatic gravity anomaly zero. This is not very far from the truth, because nearly complete isostatic equilibrium prevails. It is also clear that we still do not have sufficient material to develop successfully the gravity anomalies in spherical harmonics.

William Kaula (Fort Belvoir) told about the "Accuracy of the gravimetric determination of the deflections of the vertical." Starting from the studies of Hirvonen, he showed how big will be the error in the deflections of the vertical in the gravity anomaly field when only very few gravity observations, if any, have been carried out far from the computation point.

My paper, "Combination of different methods: a look at the future," tried to show what can be done now and with what accuracy. The main achievements are as follows. (i) We can check the equatorial radius and the flattening of the meridian with relatively high accuracy. (ii) The undulations of the geoid N and the deflection of the vertical components ξ and η can be computed in all such areas where detailed gravity anomalies exist. (iii) At the initial points of the different geodetic data, the quantities N , ξ , and η must be computed with very high accuracy; an extremely good local gravity station net must exist in the neighborhood of these points. (iv) When we know N , ξ , and η at the initial points of the geodetic data of different continents, we can easily convert all these systems to the same world system. (v) We can also compute the distances across the oceans with the accuracy of 100 to 200 meters. The largest part of the error is brought about by the error in the equatorial radius of the earth. (vi) When we correct the astronomical latitude and longitude, using the gravimetric deflection of the vertical, we can use any such astronomical point as control point of the small-scale maps beginning from scale 1/100,000. The accuracy of all these computations will be the higher, the better gravity anomaly maps we have. The values we get now can be corrected, say after 5 years, easily considering only the effect of the additional material obtained later on.

Bela Szabo (Aeronautical Chart and Information Center) gave a paper showing how important it is from the point of view of long-range navigation to establish a uniform world geodetic system.

The symposium was opened with a word of welcome by J. Osborn Fuller, associate dean of the College of Arts and Sciences at Ohio State, and by my opening address. Paul M. Pepper (Mapping and Charting Research Laboratory), Walter D. Lambert, Paul Herget, and Albert J. Hoskinson served as chairmen of the sessions. There were visits to the

new headquarters of the Institute of Geodesy, Photogrammetry and Cartography and to the Mapping and Charting Research Laboratory.

It was interesting to realize how big an interest in this subject exists in the United States. No less than 28 different governmental and private organizations and universities were represented; altogether, about 100 scientists attended. It was important too that quite a few scientists of international recognition, such as Garland, Herget, Heyden, Hirvonen, Hoskinson, Hynek, Kukkamaki, LaCoste, Lambert, Markowitz, Rice, Ross, Woolard, Worden, and Worzel, participated in the symposium or sent their papers to be delivered.

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Aviation Writers

The first Congress of the International Society of Aviation Writers will be held in Washington, D.C., 2-6 Apr. A special feature of the congress will be a complete briefing on the International Geophysical Year. The writers will also hear addresses on developments in various fields of aviation. Seminars will be held on topics of importance to international aviation writers. Part of the Washington congress will be devoted to organizational matters, since this will be the first formal meeting of the society.

Participants have been invited to the sessions of the American Rocket Society, which is meeting at the same time. Of special interest will be that society's sessions on the Vanguard project.

It is the ISAW's plan to alternate its meetings from hemisphere to hemisphere to enable as many aviation writers as possible in different parts of the world to attend. For information about the Washington congress, communicate with the program chairman, Erik Bergaust, 1001 Vermont Ave., NW, Washington, D.C., U.S.A., who will forward a detailed program and arrange accommodations.

ACS Miami Meeting

Some 6000 chemists and chemical engineers from all parts of the United States and several foreign countries will convene in Miami, Fla., for the 131st national meeting of the American Chemical Society, 7-12 Apr. John S. McAnally, assistant professor of biochemistry in the University of Miami School of Medicine, Coral Gables, has been named general chairman of the semi-annual conference, which will be the

largest spring meeting of the society in its 81-year history.

Chemical research on the problems of aging, development of flame-resistant cotton and rayon, and the increasingly important role of nuclear technology in the petroleum and chemical industries are among the subjects to be discussed in 1358 reports during the week. One hundred fifty local sections of the society, serving all 48 states, the District of Columbia, Puerto Rico, and Hawaii, will be represented.

A new class of pain-relieving drugs, chemical contributions to the citrus fruit industry, and improvements in paints, plastics, and other chemical products will be described at technical sessions sponsored by 20 scientific and technical divisions of the society. Nutrition, air pollution, cancer, and the status of chemical education are among the many subjects to be considered.

The Priestley medal, highest honor in American chemistry, will be presented to Farrington Daniels of the University of Wisconsin, world authority on both atomic and solar energy, at a general assembly of the society to be held in the Band Shell, Bayfront Park, on 8 Apr. Daniels will speak on "Chemistry and the world's energy needs." Peter J. W. Debye of Cornell University, Nobel prize winner in chemistry in 1936, is among the 15 other outstanding scientists who will receive awards at the general session.

Willard F. Libby, member of the U.S. Atomic Energy Commission, is one of the speakers who will be heard at luncheons and dinners sponsored by several ACS divisions. He will address a joint luncheon of the Division of Industrial and Engineering Chemistry and the Division of Petroleum Chemistry on "The chemist and peaceful uses of the atom."

Information Retrieval

Western Reserve University will sponsor a Symposium on Systems for Information Retrieval, 15-17 Apr., at Masonic Auditorium in Cleveland, Ohio. The symposium for the first time will include demonstrations of working equipment as well as systems presentations.

Closed-circuit television between the exhibit areas and the auditorium will be used to coordinate the demonstrations of equipment with the systems presentations. The equipment is being furnished by Commercial Controls Corporation, Dage Television Division, Thompson Products, Inc., International Business Machines Corporation, the Ohio Bell Telephone Company, and the Remington Rand Corporation. Western Reserve's searching selector, now completed, will also be used in the program.

The university's School of Library Science and its Center for Documentation and Communication Research will be hosts at the conference.

Banquet speakers will be Robert C. Watson, U.S. Commissioner of Patents, and Verner W. Clapp, president of the Council on Library Resources. One of the highlights of the program will be "The intercontinental guided missiles demonstration." This will be a practical demonstration of the use of world-wide telecommunications in the process of information retrieval. James D. Mack, librarian of Lehigh University, will conduct the demonstration with the cooperation of the Ohio Bell Telephone Company and the Radio Corporation of America. Complete information on the conference is available from the Dean, School of Library Science, Western Reserve University, Cleveland 6, Ohio.

High-Energy Physics

Some 300 nuclear physicists, 100 more than last year, will assemble at the University of Rochester 15-19 Apr. for the seventh annual Rochester Conference on High Energy Physics. The participants will include four Nobel prize winners and many research directors from the leading laboratories in this country and 25 foreign nations.

Approximately 85 visitors from abroad are expected to attend the conference, which is sponsored by the National Science Foundation, the U.S. Atomic Energy Commission, the Office of Naval Research, the Air Research Development Command, International Union of Pure and Applied Physics, and the University of Rochester. Industrial sponsors contributing financial support are General Motors, General Dynamics, the Rand Corporation, Hughes Aircraft, Ramo-Wooldridge Corporation, and four Rochester firms. Robert E. Marshak, head of the Rochester physics department, is conference chairman.

Scientists in the following countries have received invitations: Australia, Belgium, Bolivia, Brazil, Canada, Czechoslovakia, Denmark, England, France, Germany, India, Ireland, Israel, Italy, Japan, Mexico, the Netherlands, Norway, Pakistan, Poland, Scotland, Sweden, Switzerland, the Soviet Union, and Yugoslavia. A 2-week tour of high-energy installations in the United States has been arranged for the foreign delegates at the close of the Rochester conference. The group from abroad also will attend the American Physical Society meeting in Washington, D.C., 25-27 Apr.

Three Russian scientists attended the Rochester conference last year for the first time and talked freely about the work in nuclear physics in the U.S.S.R.

This is the first year that invitations have been sent to physicists from Belgium, Bolivia, Czechoslovakia, Norway, Poland, and Yugoslavia.

Fourteen American scientists, including Marshak, were invited by the U.S.S.R. Academy of Sciences to a high-energy physics conference in Moscow last May following the Rochester conference. They reported that they were given full opportunity to inspect Soviet scientific installations and received a great deal of valuable information on Soviet scientific and technologic activities and achievements, both during the Stalin era and since.

The purpose of the Rochester conference is to promote the interests of fundamental research in the field of high-energy nuclear physics by open, informal discussion and exchange of information among members of the world community of science. All of the information discussed at the meetings deals with non-secret research and will be summarized and published later for public distribution in a volume of proceedings.

Venereal Diseases

The eighth annual symposium on Recent Advances in the Study of Venereal Diseases will be held in the auditorium of the Department of Health, Education, and Welfare, Washington, D.C., 24-25 Apr. The sessions are open to all interested physicians and workers in allied professions. Hundreds of participants from all parts of the country, including many experts on venereal disease, attend annually to exchange the latest available information. Topics to be discussed include basic and clinical research, serology, epidemiology, treatment, program operation, and professional education.

Society Elections

■ Tau Beta Pi: pres., Harold M. King; v. pres., Walter C. Voss; sec.-treas., Robert H. Nagel, University of Tennessee, Knoxville; sec.-treas. emeritus, R. C. Matthews.

■ National Association for Research in Science Teaching: pres., Nathan Washington, Queens College; v. pres., Thomas Fraser, Morgan State College; sec.-treas., Clarence M. Pruitt, University of Tampa.

■ Optical Society of America: pres., Ralph A. Sawyer, University of Michigan; exec. v. pres., Irvine C. Gardner; v. pres., Stanley S. Ballard, Scripps Institution of Oceanography; sec., Kasson S. Gibson, National Bureau of Standards; treas., E. D. McAlister, Eastman Kodak Company; past pres., Deane B. Judd, National Bureau of Standards.

■ National Society for Medical Research: pres., Jules Cass; 1st v. pres., Bennett J. Cohen; 2nd v. pres., Victor Schwentker; sec.-treas., Robert J. Flynn.

■ Oklahoma Academy of Science: pres., D. E. Howell, Oklahoma Agricultural and Mechanical College; v. pres., George J. Goodman, Oklahoma University; sec.-treas., Philip E. Smith, Oklahoma University Medical Center; asst. sec.-treas., Donald E. Mitchell, Continental Oil Company; permanent sec. and representative to the AAAS Council is Orville Schultz.

Forthcoming Events

April

19-21. American Psychiatric Assoc. Research Conf., Oklahoma City, Okla. (L. J. West, Univ. of Oklahoma Medical Center, 800 Northeast 13 St., Oklahoma City 4.)

20-26. Industrial Health Conf., 12th natl., St. Louis, Mo. (E. C. Holmblad, Industrial Medical Assoc., 28 E. Jackson Blvd., Chicago 4, Ill.)

22-24. National Acad. of Sciences, annual, Washington, D.C. (H. L. Dryden, NAS, 2101 Constitution Ave., NW, Washington 25.)

23-25. Chemistry and Biology of Mucopolysaccharides, Ciba Foundation Symp. (by invitation only), London, England. (G. E. W. Wolstenholme, 41 Portland Pl., London, W.1.)

23-25. Solid State Devices in Electric Circuits, symp., New York, N.Y. (J. Griesmann, Microwave Research Inst., 55 Johnson St., Brooklyn 1, N.Y.)

23-26. American Industrial Hygiene Assoc., annual, St. Louis, Mo. (G. D. Clayton, AIHA, 14125 Prevost, Detroit 27, Mich.)

23-27. Separation of Isotopes, colloquium of IUPAP, Amsterdam, Netherlands. (J. Kistemaker, Laboratorium voor Massaspectrografe, Hoogfe Kadijk 202, Amsterdam C.)

24-25. Industrial Research Conf., Chicago, Ill. (C. E. Barthel, Armour Research Foundation, Illinois Inst. of Technology, 10 W. 35 St., Chicago 16.)

24-25. Recent Advances in the Study of Venereal Disease, 8th annual symp., Washington, D.C. (W. J. Brown, Program Committee Chairman, Communicable Disease Center, Atlanta, Ga.)

24-26. Purity Control by Thermal Analysis, IUPAC, Amsterdam, Netherlands. (W. M. Smit, Central Inst. for Physico-Chemical Constants, Biltstraat 172, Utrecht, Netherlands.)

24-26. Sanitary Engineering Conf. on Solids Handling and Anaerobic Digestion, New York, N.Y. (W. W. Eckenfelder, Jr., Civil Engineering Dept., Manhattan College, New York 71.)

24-27. Plant Quality, 2nd internat. colloquium, Paris, France. (L. Genevois, Faculté des Sciences, Université de Bordeaux, 20, Cours Pasteur, Bordeaux, France.)

25-26. Institute of Environmental En-

gineers, 1st annual tech. conf., Chicago, Ill. (G. D. Wilkinson, IEE, 9 Spring St., Princeton, N.J.)

25-26. Midwest Bentholological Soc., annual, Urbana, Ill. (A. Lopinot, 205 W. Osie, Gillespie, Ill.)

25-27. American Physical Soc., Washington, D.C. (K. K. Darrow, APS, Columbia Univ., New York 27.)

25-27. West Virginia Acad. of Science, annual, Keyser. (M. Ward, Glenville State College, Glenville, W. Va.)

25-29. Pan American Cancer Cytology Cong., Miami, Fla. (J. E. Ayre, New York Univ., New York, N.Y.)

26-27. Alabama Acad. of Science, annual, Jacksonville. (H. A. McCullough, Dept. of Biology, Howard College, Birmingham, Ala.)

26-27. American Assoc. of University Professors, annual, New York, N.Y. (R. F. Fuchs, AAUP, 1785 Massachusetts Ave., NW, Washington 6.)

26-27. Iowa Acad. of Science, annual, Cedar Falls. (J. L. Laffoon, Dept. of Zoology and Entomology, Iowa State College, Ames.)

26-27. Kentucky Acad. of Science, Mammoth Cave. (G. Levey, Berea College, Berea, Ky.)

26-27. Mississippi Acad. of Sciences, annual, Columbus. (C. Q. Sheely, State College, Miss.)

26-27. Montana Academy of Sciences, 17th annual, Billings. (L. H. Harvey, Montana State Univ., Missoula.)

26-27. South Dakota Acad. of Science, annual, Sioux Falls, S.D. (J. M. Winter, Botany Dept., Univ. of South Dakota, Vermillion.)

26-28. Cooper Ornithological Soc., annual, Los Angeles, Calif. (J. Davis, Hastings Reservation, Jamesburg Route, Carmel Valley, Calif.)

27-2. Scientific Apparatus Makers Assoc., 39th annual, White Sulphur Springs, W. Va. (SAMA, 20 N. Wacker Dr., Chicago 6, Ill.)

28. American Soc. of Hospital Pharmacists, New York, N.Y. (Mrs. G. N. Francke, 1812 Norway Rd., Ann Arbor, Mich.)

28-30. American Assoc. of Colleges of Pharmacy, annual, New York, N.Y. (G. L. Webster, Univ. of Illinois College of Pharmacy, 808 S. Wood St., Chicago 12.)

28-2. Southwestern and Rocky Mountain Division-AAAS, annual, Tucson, Ariz. (F. E. E. Germann, 1800 Sunset Blvd., Boulder, Colo.)

28-3. American Pharmaceutical Assoc., annual, New York, N.Y. (R. P. Fischelis, APA, 2215 Constitution Ave., NW, Washington 7.)

28-3. Soc. of American Bacteriologists, annual, Detroit, Mich. (J. H. Bailey, Sterling-Winthrop Research Inst., Rensselaer, N.Y.)

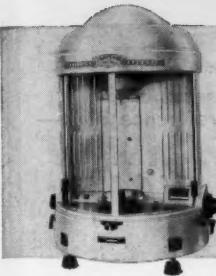
29-30. National Assoc. of Boards of Pharmacy, annual, New York, N.Y. (P. H. Costello, NABP, 77 W. Washington St., Chicago 2, Ill.)

29-1. American Assoc. of Spectrographers, 8th annual, Chicago, Ill. (T. H. Zink, H. Cohn & Sons, 4528 W. Division St., Chicago 51.)

(See issue of 15 March for comprehensive list)

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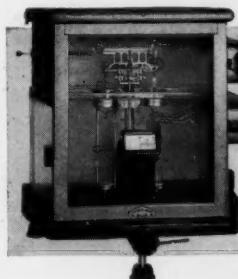


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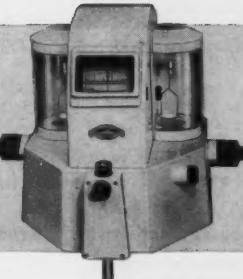


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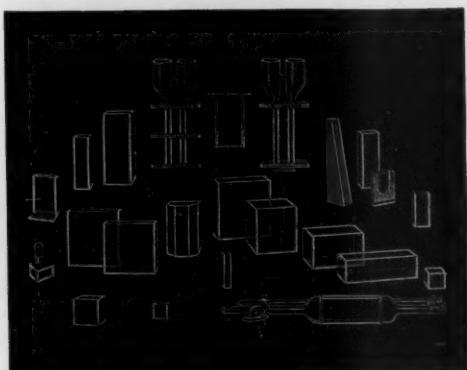
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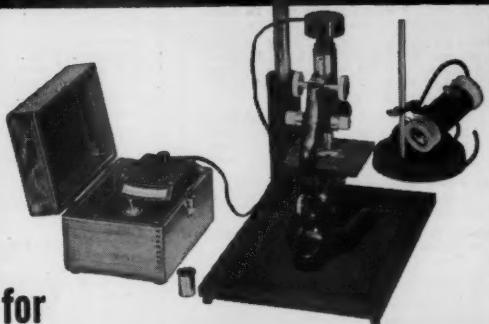
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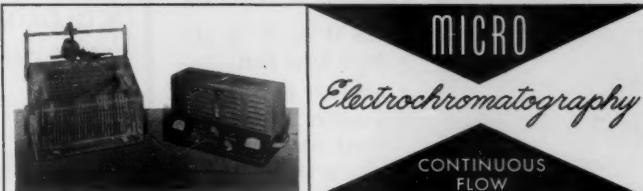
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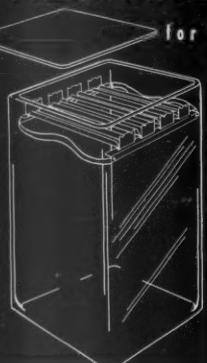
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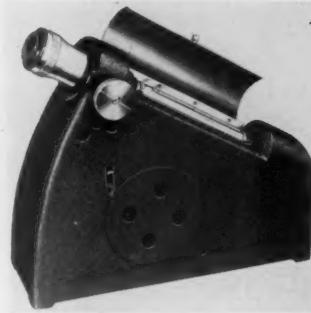
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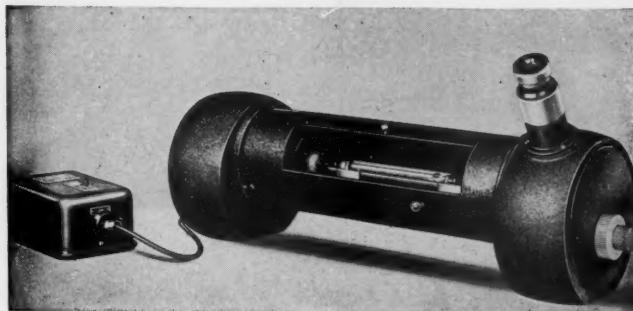
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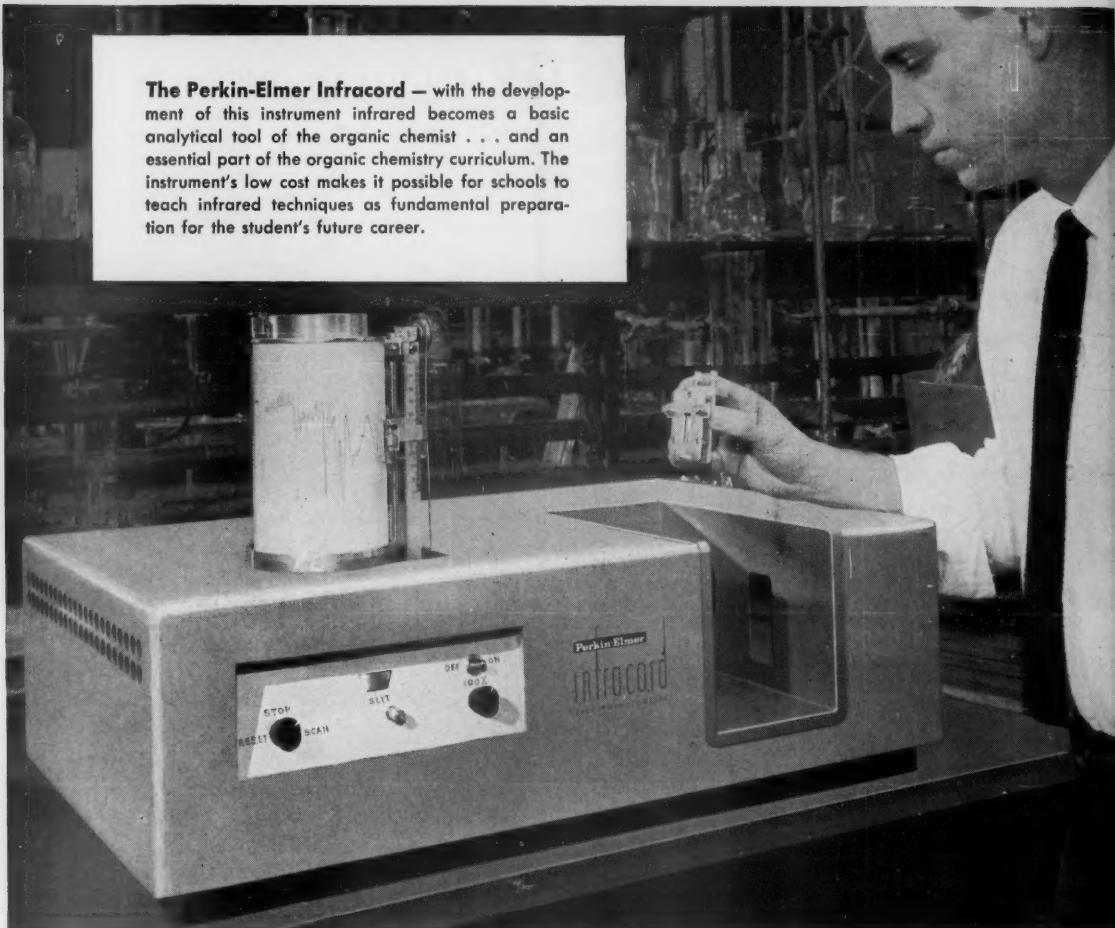
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